Vol. 46 No. 4 APRIL, 1953

Quarterly

of the

National Fire Protection Association

INTERNATIONAL

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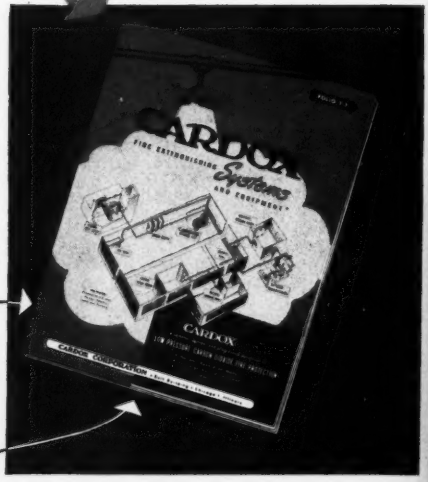

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Vol. 46 No. 4 April 1953

Quarterly

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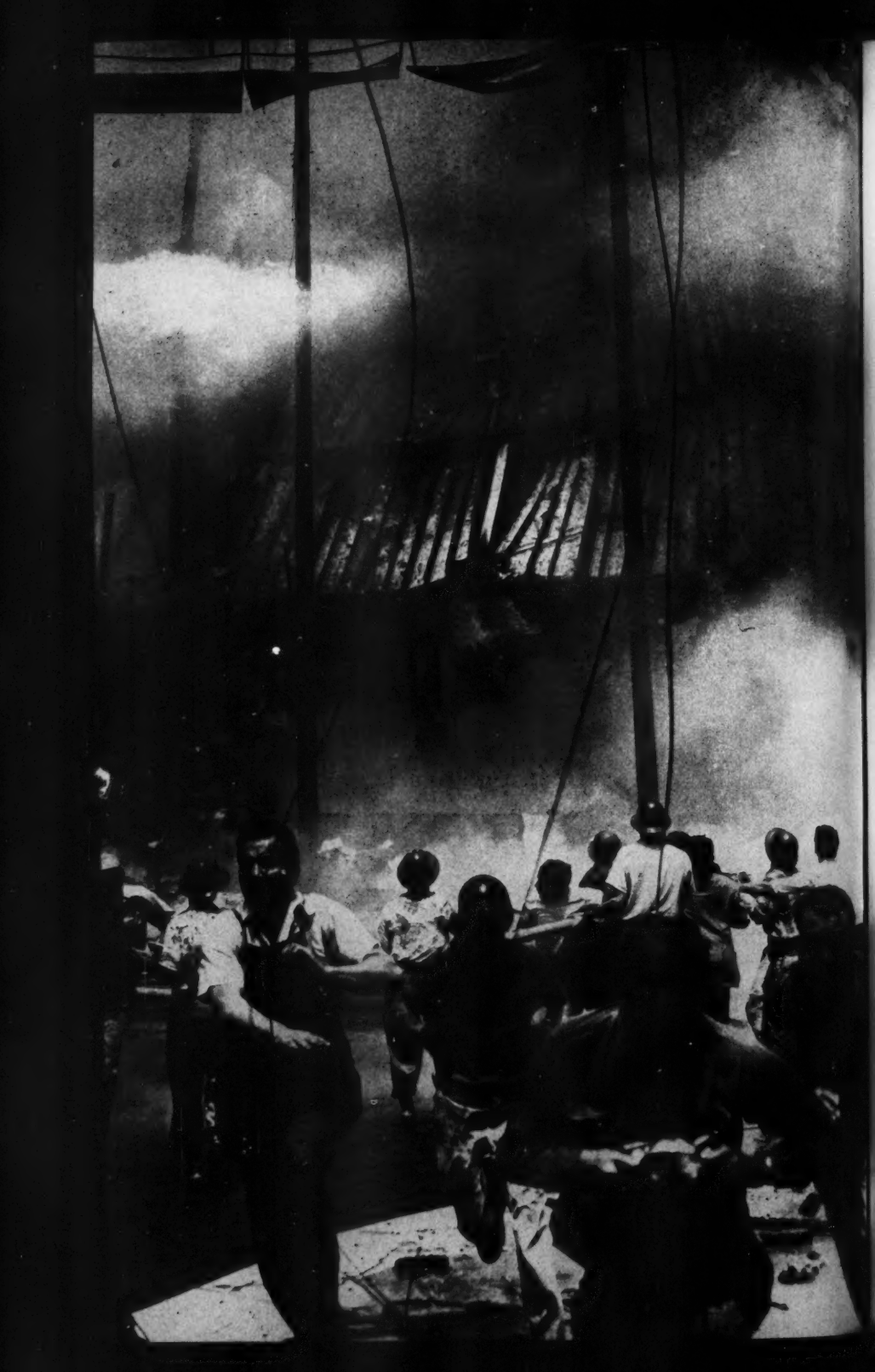

Quarterly

of the

NATIONAL FIRE PROTECTION ASSOCIATION

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Vol. 46 No. 4 **April 1953**

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Frontispiece: First Prize Winner, Third Annual Fire Foto Contest

Herb Carleton, *Van Nuys* (Calif.) *News* photographer, won the Third Annual Fire Foto Contest (see Page 312 of this *Quarterly*) with this panic scene following the May 16, 1952 Warner Brothers Studio fire (see January 1953 *Quarterly*, pages 267-268). The photo was taken with a 4 x 5 Speed Graphic (1/200, f.16, Type B film).

Accounts of fires appearing in the Quarterly are copies of or extracts from reports forwarded to the Association except where otherwise indicated. The Association, as a body, is not responsible for the statements or opinions of any of its members. This publication is indexed by Engineering Index, Inc.

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The National Fire Protection Association is a non-profit technical and educational organization devoted to the reduction of loss of life and property by fire with more than 14,000 members. The *Quarterly* is one of the publications regularly provided to members. Other membership publications include a monthly *Fire News, Advance Reports* and *Proceedings* of the Annual Meetings, a *Year Book*, and many leaflets, pamphlets and posters issued throughout the year on fire prevention and control.

Technical committees of the Association develop means to safeguard life and property through the publication of standards covering all phases of fire prevention and protection. Your membership in the Association (annual dues $12.50) affords an opportunity to keep abreast of these developments and, by being a member, you help support this humanitarian activity. Popular educational literature on fire safety is constantly being produced by the NFPA for distribution through its members to the general public.

All members of the Association and the public are invited to NFPA meetings. The following dates are now on the Calendar:

NFPA Calendar

1953	
May 18-22	NFPA Annual Meeting, Palmer House, Chicago
Oct. 4-10	Fire Prevention Week
Oct. 29-30	NFPA Regional Meeting, Providence, Rhode Island
1954	
May 17-21	NFPA Annual Meeting, Hotel Statler, Washington, D. C.
Sept. 20-22	NFPA Regional Meeting, Seattle, Wash.

The closing date for articles submitted for the Quarterly is the 15th of the month preceding publication.

Editorials

Coming To The Meeting?

YOU are the fire prevention and protection hope for 1953. You, the reader of this technical journal, can do more to "Promote Prevention and Provide Protection" than a million words, a gallery of photographs and all of Fort Knox's gold. You have the interest and the resources for accomplishment!

Annual Meetings of the NFPA are designed to "Promote Prevention" and to furnish technical guidance on how best to "Provide Protection." These four "P's" represent the purpose of the NFPA and our 1953 Annual Meeting is designed to further this program. Your attendance is vital, for, without members, no progress can be made.

We request that you refer to the Preliminary Program published in the April *Fire News* and review what it has to offer. To the scope and breadth of the subjects covered, add the important opportunities for association with your fellow fire protectionists and we feel sure you will find the way and the time to come to the meeting.

We'll be seeing you there — Palmer House, Chicago, May 18-22!

•

The Stairway That Wasn't There

SEVERAL hundred budding school teachers at Lowell State Teachers' College in Lowell, Mass. were unwilling participants in a practical demonstration of fire carelessness last February 5 that once again highlights the incredible indifference to fire safety measures that we will still encounter all too frequently.

The Lowell State Teachers' College is a typical old style three-story and basement brick-joisted building with wide open wooden stairways running from the basement to the third floor at each end of the building. Because of the rather obvious fire hazards of the building, it had apparently been decided to take some measures to make the building more reasonably fire-safe and so the wooden stairway at the *east* end of the building had been removed for the purpose of installing a metal stairway, thus leaving nothing but an open pit some 54 feet in depth. (See photo below.)

Lowell Sun Staff Photo

On the morning of February 5, while classes were in session, a welder working at the bottom of this *east* stairwell set fire to a plywood locker and wooden shelves close by and this in turn ignited the varnished wooden sheathing on the stairwell walls causing a rapid fire which spread immediately to the third floor and mushroomed into the third floor corridor. The pupils in this third story classroom sat facing a blackboard which contained in large letters the warning: "Fire Drill, one long ring, use

east stairway, single file." But the *east* stairway wasn't there!

There were no fire escapes on the building and no fire drills had been held since the school had started in September. The pupils in this room had to make their way through smoke and flames to the *west* side stairway. Some 39 were removed to hospitals and a number of these were severely burned. The surprising thing is that none of the pupils lost their lives and what might have happened if the fire had started at the other end of the building and come up the only remaining open stairway is almost too horrible to contemplate.

That a situation like this can be permitted with apparently neither workmen, administrators, teachers, nor pupils conscious of the invitation to death and destruction inherent under the circumstances offers still another challenge to fire safety education. No one interested to any degree in fire protection and fire prevention work can afford to be to the slightest extent complacent. If situations such as the one just described can happen in a crowded building of this sort without anyone recognizing the life hazard involved to the point that they will do something about it, then we have signally failed to get across even the most elementary message of fire safety.

Fire Fotos

THE fire pictures which appear on pages 312-329 are some of the best entries in the Third Annual Fire Foto of the Year Contest. They graphically prove an important point: a picture indeed is "worth ten thousand words."

Fire is an abnormal experience to most of us. Too many people seem to think that fire is always going to hit "the other fellow" — never them. Yet one of the basic objectives of fire prevention is to teach folks a "healthy" respect for fire. Some of the Indian tribes used to have an effective way to do this, but it was rather drastic. They would purposely burn young children so they would physically know what uncontrolled fire could do. Civilized people have to use the printed page to impart the same lesson but it's difficult to translate the actual sear of the flame into cold words.

Dramatic fire pictures can sell fire prevention better than cold type; they should be used more.

Fulmer & Cole, Inc.

It is hoped that the horror of the ruins of the Littlefield's Nursing Home sufficiently aroused the citizens of Florida and other states to demand fire-safety for the occupants of nursing homes. Wright's Nursing Home, shown in the picture, was similar in appearance to the home destroyed by fire.

United Press

Florida Nursing Home Fire

By Chester I. Babcock
Manager, NFPA Fire Record Department

Thirty-two patients and a nurse were trapped and killed by fire at the Littlefield's Nursing Home near Largo, Florida that occurred in the early morning hours of March 29. In addition, one of a group of rescued patients being transported by car to a hospital suffered fatal injuries when the vehicle was involved in an accident. The driver of the car was killed.

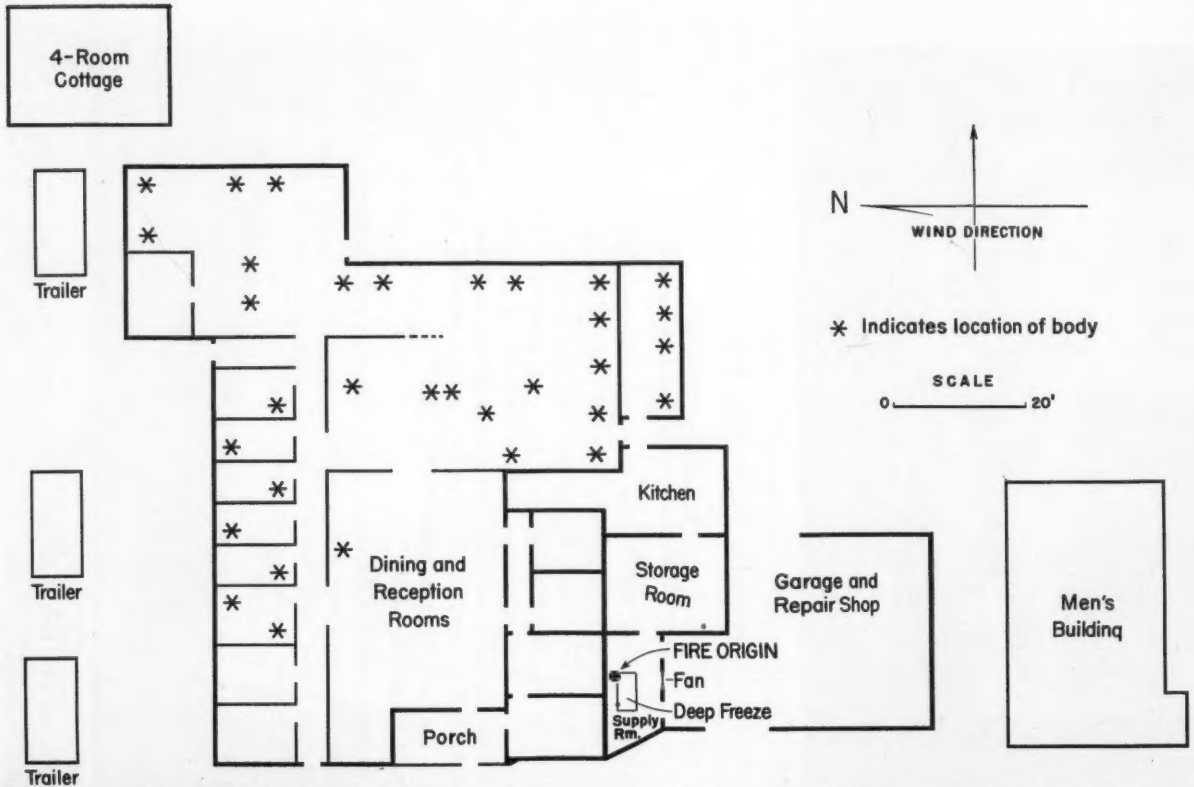
Those who have read the report of the Hillsboro Nursing Home fire in which twenty were killed* will note a striking similarity between the factors responsible for the loss of life at the Missouri and Florida Homes. There is no doubt from the experience at these two fires that the lives of elderly people with physical infirmities and declining mental faculties are seriously endangered by fire if housed in nursing homes having highly combustible interior finish, in homes where insufficient personnel are available to aid the patients in an emergency, and where no automatic protection is provided to assure prompt detection and extinguishment of fire.

Note: The author wishes to express his sincere appreciation to Deputy State Fire Marshals Carl Davis, John Ferlita and Guy Arendell, Clearwater Fire Chief Peter Treola and Pinellas County Sheriff Sid Saunders for their excellent cooperation and assistance.

Location and Description of the Home

Littlefield's Nursing Home was located in Pinellas County, Florida, approximately four miles south of the town of Largo, seven miles south of the city limits of Clearwater and fifteen miles north of St. Petersburg. Situated by the side of a lightly traveled road and in the midst of grapefruit and orange groves, the attractively painted, rambling, 1-story nursing

*See "Twenty Patients Dead in Nursing Home Fire," published in the January 1953 *Quarterly*, pages 172-175.



Location and size of buildings at Littlefield's Nursing Home. Since no architect's plans had been made, the approximate location of all partitions could not be shown. Those included are based on the owner's recollection.

Photo shows main entrance to the Littlefield's Nursing Home, indicated by "Porch" on diagram.

home, at least from outward appearance and location, would seem to assure a pleasant and peaceful existence for its elderly occupants.

As shown in the diagram, two 1-story buildings were the principal structures at the Home. The main building, where the fire originated and in which thirty-three deaths occurred, was 7,200 sq. ft. in area. This building housed 45 elderly patients, Mr. and Mrs. William L. Littlefield, and a nurse. When originally built it had been occupied as a fruit store and comprised approximately the area indicated on the diagram. For twenty-odd years, however, the building had been used as a nursing home and from time to time, as money permitted, additions had been made. Since no architect's plans were made and no construction permits were required, and since most of the work had been done piecemeal by Mr. Littlefield, it was impossible to obtain accurate information on all phases of the interior layout of the building. However, it was stated by Mr. Littlefield that the north and east portions of the main building (where most of the lives were lost) had been added about three years before the fire and that framing and exterior siding were wood while the ceiling, as well as room and corridor partitions, were constructed of highly combustible fibreboard which he did not recognize as involving any particular fire hazard. Generous amounts of combustible fibreboard had also been used in older parts of the wholly combustible structure. A shallow concealed space formed by the combustible fibreboard ceiling and the wood roof extended over most of the building. Most of the patients' rooms were bounded by an exterior wall and all such rooms were said to have had at least one outside window (windows are not shown in the diagram).

Thirteen old men were housed in the 1,000 sq. ft. 1-story building located eleven feet south of the main building. This "men's building," also built about three years before the fire, was constructed of wood framing and exterior siding with fibreboard ceilings and interior wall finish.

Location and size of buildings at Littlefield's Nursing Home. Since no architect's plans had been made, the approximate location of all partitions could not be shown. Those included are based on the owner's recollection.

A middle-aged man and his invalid wife occupied the 1-story, 4-room cottage (wood framing and exterior siding, plasterboard walls and ceilings) located six feet from the northeast corner of the main building.

Three house trailers were parked in a row parallel to and approximately twenty feet north of the north wall of the main building. One was occupied by a maintenance man for the nursing home, another by a nurse. The third was apparently unoccupied.

Fire Protection

Located outside the limits of any organized community, the Littlefield's Nursing Home (as were, and are, the several others in the vicinity) did not have the protection of a local fire department. The Largo, Clearwater and Florida Forest Service Departments had no hesitancy about sending equipment to a fire at any of the Homes but the effectiveness of apparatus from these departments was extremely limited because of long running distances and lack of an adequate water supply for fire fighting when apparatus finally reached the scene.

Automatic detection or sprinkler systems were not installed, no attendant was assigned to stay awake to discover any fire that might start during the night, and in fact the only semblance of fire protection at the Home consisted of three or four soda-acid extinguishers.

Here then was a nursing home pregnant with conditions that could have been readily diagnosed by a qualified fire inspector as pointing inevitably to a loss of life disaster should fire occur at night. But, as far as could be determined, no fire inspector had

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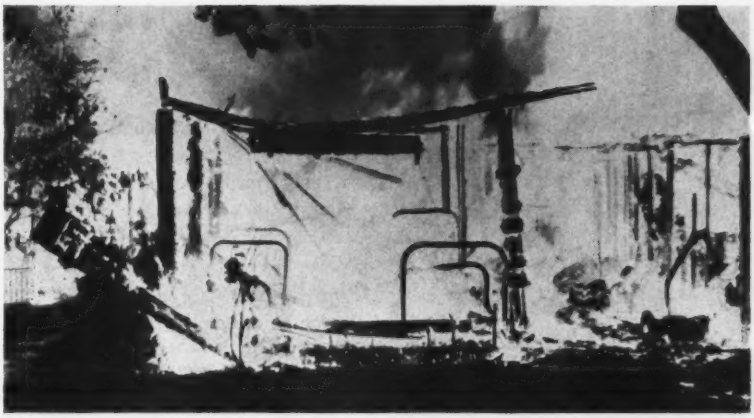
View of ruins of main building looking from rear toward street. The fire originated in the vicinity of metal boxes (refrigerators and deep freeze) in left center background. Part of new section of building was in foreground.



United Press

Firemen responding from Clearwater, about 7 miles away, were confronted with this hopeless situation.

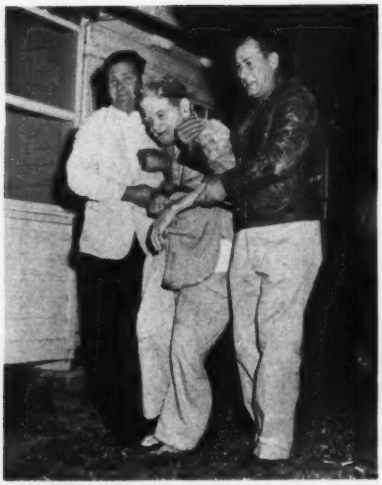
ever made an official investigation of the home during its twenty-odd years of existence — so, when the night fire eventually did occur, thirty-three lives were lost.

The Fire

Before retiring for the night at 11:00 P.M., March 28, the Littlefields had checked the premises and found everything in order. No evidence of fire was apparent at 2:30 A.M. when Mrs. Littlefield got up briefly to quiet a patient. It was about 3:15 A.M. when a patient knocked on their door and told them the Home was on fire. Smoke was then spreading throughout the main building and when a light switch was operated it was found that all lights in the building were out of order (apparently put out of service by the fire). The supply room was found to be heavily charged with smoke, with flames extending up a wall from the 15-inch space between the rear of a deep freeze unit and a wooden wall. Since smoke and heat were so intense that the supply room could not be entered, Mr. Littlefield carried a 2½-gallon soda-acid extinguisher outside and discharged it into the supply room through a ventilating fan opening. A second extinguisher was obtained and discharged through a window broken by the heat, but, in the words of Mr. Littlefield, he soon "saw that it was folly" to attempt to control the fire with extinguishers, and went inside to see about getting the patients out.

Mr. and Mrs. Littlefield, assisted by two attendants who had been aroused by the commotion, rushed through the main building, opening doors and shouting to the patients to get out. But the occupants of the nursing home were old people, feeble, and in many instances without their full mental faculties. Consequently, when being awakened from a sound sleep, they reacted in a stunned and uncomprehending manner, and instead of proceeding into the smoke-filled dark corridors or climbing out ground floor windows, they stayed in their beds.

The few bedridden were carried out but very little assistance could be offered to the others before flames, fanned by a 15 mph west wind, raced through the highly combustible building.



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In many nursing homes, most of the patients are feeble and senile and require the assistance of able-bodied attendants if it is necessary for them to escape from fire.

About this time it was discovered that fire was spreading over the exterior of the men's building and entering windows broken by the heat. The thirteen old men in this building were herded to safety by Mr. Littlefield just before the building became completely enveloped.

Typical of the reaction of some of the patients to rescue attempts was one old woman who was twice pulled from her room through a window but each time returned. The heroic efforts of the handful of rescuers during the five or so minutes when rescue operations were possible are deserving of high praise. A nurse who made two or three trips into the main building was finally trapped and killed.

Fire Fighting

Futile attempts to control the fire with soda-acid extinguishers have been described. There were no further attempts at fire fighting until about 3:51 A.M., or when the first apparatus arrived. The Clearwater Fire Department had been telephoned at 3:36 A.M. by the proprietor of a nursing home across the street from the fire. A 235-gal. tank truck, accompanied by Chief Peter Treola, arrived at the scene about 15 minutes later but, by then, both the main building and the adjacent men's building were a mass of flames and fire was extending to the cottage and trailers. Heat was so intense that siding on Wright's Nursing Home, across the street, was blistering and had not water been used to cool this 1-story building, it too would undoubtedly have ignited.

Immediately after the Clearwater Fire Department was called an attempt was made to telephone the Largo Department. However, in the brief interval between the two calls the telephone wires had burned and response of the Largo firemen was delayed until someone drove the three miles to the station to give the alarm. In all, five tank trucks eventually arrived at the scene, two from Clearwater, one from Largo and two small Florida Forest Service trucks. Considering the long distances apparatus had to travel to reach the scene, the limited amounts of water available and the time required to refill tanks at a Largo hydrant, the work done by fire fighters was commendable. Damage at the exposed nursing home was confined to blistered paint, and half the cottage adjacent to the main building was saved.

Cause of the Fire

Cause of the fire is always of prime importance to the local citizenry in any disaster causing large loss of life and, of course, there is no denying the axiom that if all causes of fire are removed, no fire can occur. The NFPA recognizes the importance of learning the cause of a fire, but in disasters of this nature, considers of even

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Charred human bones and twisted metal beds are gruesome reminders that nursing homes with highly combustible interior finish, understaffed and without automatic fire protection are death traps for their elderly or invalid occupants.

greater importance those factors responsible for the loss of life — factors which may often be totally unrelated to the cause. In this instance the cause of the fire at the time of this writing had been narrowed to the two possibilities (1) set by some patient who may have had pyromaniacal tendencies, or (2) a fault in the electric motor of the deep freeze unit where the fire appeared to have originated. Whichever the cause, however, it was not so much responsible for the terrible loss of life as were the various fire protection weaknesses noted — highly combustible interior finish, absence of automatic protection, insufficient attendants and remote public fire protection. These are the factors primarily responsible for the loss of life and these are the factors that if eliminated from nursing homes across the country will reduce the possibility of heavy loss of life in fires, whatever the cause.

Who Is to Blame!

Following the pattern of all fires involving large loss of life, a rudely awakened public has demanded that responsibility be placed and that those guilty of permitting the conditions responsible for this disaster be called to account—little realizing that a large measure of responsibility for these thirty-five deaths rests on the public itself.

From all information that could be obtained no state, county or other public agency was specifically responsible for the fire safety of nursing homes in Florida, a condition condoned by the public. And what about Mr. and Mrs. Littlefield, proprietors of the home? They were people with a deep affection and sympathy for the old people in their care but their conception of fire safety apparently had not progressed beyond the soda-acid extinguisher stage. True, the Littlefields assumed responsibility for the safety of these people

Located on a lightly traveled road and in the midst of orange and grapefruit groves, the Littlefield's Nursing Home seemed from outward appearance and location to be a desirable place for old people to live.

when they took them in, but was it not the responsibility of the public to see that the Littlefields knew and were meeting their responsibilities? Surely the Littlefields might to some degree be excused if they assumed that their nursing home met minimum safety standards; for had not public welfare agencies placed patients in their home!

Without attempting to relieve any individual or agency of its share of blame for the lives lost at this fire, it seems clear that prime responsibility rests with the public, in this case, the citizens of Florida. Similar nursing home fires will continue to occur throughout the country until the public demands adequate safety standards for nursing homes.

The argument was voiced repeatedly at Largo that the cost of providing fire-safe nursing homes would put most of the homes out of business. Certainly safety costs money! So does food, but both are necessary for life on earth. There are two possible solutions: more money for nursing home operation or more efficient use of available money. If it is actually true that the cost of providing adequate fire safety will force nursing homes to close, then the obvious conclusion is that nursing home operators must receive a larger fee for their service. In most cases, however, inadequate funds as the excuse for the existence of life-hazardous conditions can be proved to be groundless and it can be readily shown that a more enlightened use of the money and facilities at hand will afford the old people in these homes the protection from fire they have a right to expect.

At Largo, for example, it is a safe assumption that no one would have been trapped had a noncombustible rather than combustible interior finish been used, had the working time of attendants been arranged so that at least one person was on duty and awake at all times, and had a dependable automatic fire alarm system been installed. Sprinkler protection, although perhaps involving more money than was immediately available, certainly could have been financed, and would have provided ideal protection.

EDITOR'S NOTE: The NFPA Building Exits Code, prepared by our Committee on Safety to Life, contains general standards on exits and related features of life safety from fire. An additional section of the Code is now under development by the committee to provide specific recommendations for the practical application of the principles of the Building Exits Code to nursing homes.

Meeting of Board of Directors

New York, January 22, 1953

Present

ALLEN L. COBB, President
T. SEDDON DUKE, Vice-President
JOHN A. NEALE, Vice-President
HOVEY T. FREEMAN, Secretary-Treasurer
RICHARD E. VERNOR, Chairman

Warren J. Baker	R. D. MacDaniel
A. L. Brown	George J. Richardson
C. H. Bunn, Jr.	Frank D. Ross
Loren S. Bush	W. W. Sampson
P. E. Dannenman	R. C. Sogge
J. E. Frederickson	Henry G. Thomas

PERCY BUGBEE, General Manager, ROBERT S. MOULTON, Technical Secretary, HORATIO BOND, Chief Engineer, CHARLES S. MORGAN, Assistant General Manager, M. M. BRANDON, Chairman, Electrical Section.

1. General Manager Bugbee reported on plans and the preliminary program for the 1953 Annual Meeting to be held in Chicago, May 18-22 at the Palmer House. The General Manager also reported on the organization of a Chicago convention committee under the chairmanship of Mr. Elmer F. Reske. The report was approved.

2. Treasurer Freeman reported on the finances of the Association, pointing out that the principal income items were sales of publications, membership dues, advertising and contributions and that all of these items showed increases over the same period in the previous year. Mr. Freeman observed that expenses were increasing and that our margin of income over expenditures in recent years had been much too narrow. He expressed the hope that the staff would find ways and means to continue to increase the income and reduce the expenditures.

Executive Office Activities

3. Executive office reports were presented as follows:

a. MEMBERSHIP. Mr. Bugbee reported that the membership as of January 15 stood at 14,697, the largest in the history of the Association. He paid high compliment to the work of Chairman Rainey and the Membership Committee and described current activities in membership promotion.

b. SPONSORS COMMITTEE. Mr. Bugbee reported the acceptance of Mr. T. J. Hargrave, Chairman of the Board of Eastman Kodak Company of Rochester, New York, as Chairman of the Sponsors Committee and the addition of Mr. L. M. Cassidy, Chairman of the Board of Johns-Manville Corporation to the Committee. He reported that as a result of Mr. Hargrave's campaign last fall, 58 new contributors were added.

c. PUBLICATIONS. Mr. Moulton reported on the technical and educational publications issued during the year 1952 and distributed a new and up-to-date list of NFPA publications. He also reported on the forthcoming 1953 edition of the "NFPA Handbook of Fire Protection" and some of the difficulties involved in this very large and comprehensive publication.

d. ADVERTISING. Mr. Morgan reported on the current advertising situation and the substantial increase in advertising revenue from the *Quarterly* and *Firemen* magazine.

e. FLAMMABLE LIQUIDS ENGINEER. Mr. Moulton reported on the appointment of Miles Woodworth as the new Flammable Liquids Engineer. His report was supplemented by a report from Mr. Bunn, Chairman of the Flammable Liquids Field Service Committee. Mr. Bunn reported favorably on this project.

f. FIRE MARSHALS' SECTION. Mr. Morgan reported on the activities of the Section and indicated that it was function-

ing smoothly and to the satisfaction of its members.

g. PUBLIC RELATIONS DEPARTMENT. Mr. Bugbee reported on the work of this Department including Fire Prevention Week, Spring Clean-Up Week, and the National Fire Foto Contest.* He also reported on the appointment of a new Chairman of the Public Relations Committee, Mr. Stanley Withe of Hartford and reported to the Board on a proposal of this Committee and stressed the importance of public relations work to NFPA.

h. FIREMEN MAGAZINE. Mr. Bugbee reported that the magazine was in flourishing condition with an average circulation in excess of 25,000 copies monthly. This publication is now operating in a favorable financial condition and is gaining increasing acceptance from fire departments and industrial fire brigades.

All of the above reports were approved.

4. The question of the dues schedule of the Association and the advisability of recommending an increase in dues was considered at length. No specific action was taken but the General Manager was instructed to continue to study the subject and report at the next meeting of the Board.

Advertising Council Campaign

5. The General Manager reported on the growth and acceptance of the Home Fire Prevention Campaign conducted by the Advertising Council with the NFPA as a sponsor. The Board expressed itself in favorable terms as to the value of this program and authorized the General Manager to spend not more than $10,000 of the Association's funds (taking such funds from reserves, if necessary) for this campaign during 1953.

6. The Board considered a project developed by Chairman Withe of the Public Relations Committee for the making of a technicolor animated cartoon built around the character of "Sparky," the Dalmatian firehouse dog that is featured by the NFPA and by the Advertising Council, this film to be produced by the United Productions of America, a leading Hollywood producer of such films. The Board viewed this project favorably and instructed the General Manager to proceed to develop the project and to attempt to secure the funds necessary to bring it to a successful conclusion.

7. Mr. Willis F. McMartin, author of the NFPA Retirement Plan, described the plan and answered questions from members of the Board with respect to it.

8. The General Manager described the appeal that had been sent to various foundations for financial support and reported that three foundations were currently considering the NFPA proposal for such support.

9. Vice-President John A. Neale of the Society of Fire Protection Engineers reported on the satisfactory growth and development of the Society and advised the Board that the Society was fulfilling the functions expected of it in a very satisfactory manner.

Regional Meetings, Past and Future

10. Chairman Vernor, President Cobb, Vice-President Duke, W. J. Baker, and J. E. Frederickson reported favorably on the Houston regional meeting held in December. Plans for holding a regional meeting in Providence, Rhode Island on October 29 and 30, 1953 and in Seattle, Washington on September 20 to 22, 1954 were approved.

11. The proposal to provide a Distinguished Service Award of some character in recognition of outstanding contributions to the development of fire protection was discussed. The Board decided not to establish such an award.

12. The matter of honorary life membership was discussed and the name of one candidate was approved for presentation at the forthcoming Annual Meeting.

*See Frontispiece and pages 312 to 329 in this issue of the *Quarterly*.

13. Chairman Cobb made a progress report on behalf of the Industrial Committee and advised of the Committee's intense interest in making suggestions to improve the service of the Association to its industrial members. He indicated that the Committee would have recommendations to offer to the Board at subsequent meetings.

14. Chairman Brandon of the Electrical Section reported to the Board on the current work of the Section in connection with the 1953 edition of the National Electrical Code and also reported that Mr. Frank Thornton had been retained as editorial consultant to work on an editorial revision of the Code. Funds for this were contributed by the organizations supporting the electrical field service. The report was approved.

Gases Field Engineer

15. Mr. Moulton reported that most of the necessary funds had been raised to start the Gases Field Service Project and that the Gases Field Service Committee was now engaged in hiring a Gases Field Engineer who would shortly start his activities.*

16. The General Manager reported that little progress had as yet been made in raising funds from interested groups for the proposed project of a farm and rural fire protection field engineering service, but that there were some possibilities for such support.

17. Chairman A. L. Brown reported for the Committee on Technical Committee Procedure recommending confirmation of Committee appointments as submitted to the meeting; also confirmation of those appointments delegated to the Committee on Technical Committee Procedure by action of the Board at its last meeting and incorporated in the 1952-1953 Year Book subject to Board confirmation. The appointments were confirmed.

18. Mr. Moulton reported on building code developments with particular reference to the Joint Committee on Building Codes and on the various committees of the Building Code and Construction Standards Correlating Committee of the American Standards Association. This matter was referred to the Committee on Technical Committee Procedure.

19. The General Manager reported on the completion of the East River Project with which the staff had been concerned during the past year and also reported on a current controversy between the Civil Aeronautics Board and United Airlines over the seating arrangements for coach air travel. The position of the staff on this controversy was approved .

*Mr. Clark F. Jones joined the NFPA Staff as Gases Field Engineer, April 6, 1953. (See April 1953 *Fire News*.)

Geo. L. Goodreau

Pawucket, R. I., Jan. 19, 1953. Replacement costs are soaring these days. Estimates to replace this church valued at $400,000 run as high as $1,000,000 according to newspaper reports. This is a powerful argument to use with church governing bodies by those interested in improving the fire safety of their own places of worship.

Will Your Church Be Next?

By Richard E. Stevens
NFPA Department of Fire Record

If you are a churchgoer, you certainly appreciate the opportunity to worship in the local House of the Lord of your choice. As one interested in fire safety, you must also realize the possibility of total or partial destruction of your church because most churches, by the very nature of their construction, age and use, are potentially subject to destruction by fire. In addition to offering your financial and moral support, why not stimulate interest in the fire safety of your church?

How to Attack the Problem

Before approaching the governing body, pastor or others responsible for the church property, plan your method of attack carefully. This may be done by dividing your procedures into two general headings: (1) Preparation and (2) Converting the Unbeliever.

The Preparation

Preparation should include a detailed survey of the church property for existing hazards and an analysis of the private protection provided, if any. Remember that the two most frequent causes of church fires are heating and electrical defects. According to a recent survey of church fires in NFPA fire record files, most church fires start in furnace rooms. Nonfirestopped walls, open stairways, organ and heating ducts are channels which most often spread flames from furnace rooms to other sections, particularly to attics and steeples.

In Southington, Conn. on January 29, 1953 for example, fire occurred in the basement furnace room of the First Baptist Church. Fuel oil had accumulated on the floor and was ignited in some undetermined manner. Flames spread through

United Press

Minneapolis, Minn., Feb. 18, 1953. An electrical short circuit in the cockloft resulted in the destruction of this 2-story, stone, wood joisted church.

nonfirestopped partitions and a dumbwaiter shaft to the open attic. Fire eventually destroyed the entire two-story, wood church and an addition of similar height and construction in the rear. Estimated loss, not replacement cost, was $125,000.00.

In support of the importance of properly installed and well maintained electrical installations, the recent much publicized $314,800 fire in St. Olaf Church in Minneapolis, Minn. might well be cited. In this case, fire occurred in the open cockloft due to a short circuit in the electrical wiring. Fire burned through the ceiling into the sanctuary and eventually gutted the entire structure. A fire wall prevented spread of flames to the adjoining parsonage. Other potential fire causes should not be ignored, including indiscriminate use of candles and collections of trash which invite ignition by loitering children and arsonists whose propensity for church fires is apparent.

Next investigate the local available public protection; that is, water supply, fire department services and the local fire alarm facilities. Most churches are high structures and fires occurring in attic spaces or steeples require high pressure hose streams and ladders to reach the seat of the blaze. One fire chief, reporting to the NFPA Department of Fire Record on a recent church fire in his city, stated, "This fire served to emphasize the fire department's repeated request for additional ladder equipment." Not all fire departments are equipped with modern fire fighting equipment and not all are familiar with new methods of fire fighting. A fire on January 15, 1953 occurred in the basement of a high 1-story brick, wood-joisted church. When firemen arrived, the fire was apparently confined to the basement but they were unable to gain entrance to the smoke-charged basement using solid hose streams and flames spread up an open stairway to involve the entire building. The reported loss was $265,000. An authoritative source states that the reason for the large loss was the failure of the fire department to use modern methods for combatting a confined interior fire. Conditions at the time of fire department arrival were said to have been ideal for control by application of water fog.

If your church is outside city limits and remote from public protection, including water supplies, the need for automatic protection and private fire fighting facilities is even greater. Church fires, like so many other fires, have a habit of gaining serious headway while the property is unoccupied. NFPA records show that on a basis of 232 church fires where the person detecting and reporting the fire were known, 65 per cent were outsiders or passersby, and, in 32 per cent, such fires were beyond control when first noticed. In Pawtucket, R. I. on January 19, 1953, fire occurred in the front vestibule on the first story of the 2-story brick veneer, wood-joisted Sacred Heart Catholic Church and was out of control when firemen arrived, summoned by a passerby at 1:34 A.M. Flames spread through the walls to the roof and sections of the heavy slate-covered roof collapsed soon after the start of the fire. The brick veneer, added in recent years to cover the original wood construction, prevented direct application of hose streams to the frame walls after firefighters were forced out of the building by danger of ceiling and roof collapse. Estimated loss was $400,000. Replacement estimates run to $1,000,000.

Two recent fires exemplify the total destruction that accompanies lack of water and public protection. In St. Mary's, New Brunswick, January 14, 1953, the Church of Our Lady of Mount Carmel was completely destroyed by fire that originated

Basil Day

St. Mary's, N. B., Jan. 14, 1953. Efforts of firemen were in vain as the only water was from a river 1½ miles from the fire.

from an electrical short circuit in the wall at the second story level in the 2-story wood building. Summoned by an alarm at 9:00 A.M. pumpers responded from towns 6, 28 and 40 miles away but were unable to relay water fast enough to save the structure as the nearest water supply was a river

United Press

Near Jacksonville, Fla., Feb. 22, 1953. Location: One mile outside city limits. Water supply: One 6-inch main and 1 well 1,400 ft. from the building. Construction: One story wood. Result: Total loss.

1½ miles away. The loss was $105,000. The Lake Forest Baptist Church near Jacksonville, Fla. was lost in a $56,500 fire on February 22, 1953 due to the fact that the church was located outside city limits and the only water available was from a long 6-inch main and a well 1,400 ft. from the fire. Fire in this 1-story wood building originated in an attached furnace room opening directly into the auditorium.

Make a survey of the insurance coverage of your church. If necessary, seek advice on the adequacy of the coverage so that if the church suffers a total burnout, there will be sufficient funds to rebuild.

You are now ready to prepare your recommendations for protection of the church.

Converting the Unbeliever

Probably the best convincer and most effective way to bring the problem close to home is with a fire record of church fires complete with case histories, illustrations and statistics. The NFPA has such a publication, titled "Churches Are Burning."* In presenting this material dwell primarily upon the life hazard and the financial and intangible loss to be suffered by fire.

Recommendations for improving the fire protection should be planned to include the most practical and economical solution. Automatic sprinklers or an automatic detection system should top your list of recommendations. In many cases, it will be argued that installations of this type of equipment are beyond the financial resources of most churches but don't take this answer without very closely analyzing what the facts are regarding costs. Get bids to submit and know the answers. Partial automatic protection for concealed spaces, hazardous locations or storage areas is pos-

*Single copies: $1.00 each; discount for quantities. Write to Publications Distribution, National Fire Protection Association, 60 Batterymarch Street, Boston 10, Mass.

sible with plans for expansion in the future. Improvements such as repair and replacement of wiring and heating equipment, firestopping, enclosures for vertical and horizontal openings, adequate exit facilities and protection of records can be undertaken on a schedule spread over a period of time. In some instances, such as provision of adequate exits, prompt corrective action may be necessary.

Some immediate fire safety measures can be carried out with little effort. Good housekeeping, observation of no smoking rules, identification of exits and fire safety instructions to the janitor are a few of these. Social groups of the church may regularly assign one or more of their members to clean up after their meetings. A recent fire in a Baptist Church in Lethbridge, Alberta illustrates the need of janitor training in fire safety. On Jan. 15, 1953, fire occurred in the janitor's closet near the furnace in the basement of the 2-story brick, wood-joisted church. Fire burned through the ceiling to the choir loft and the roof. The interior of the building was gutted; the church records destroyed. Fire was believed caused by spontaneous ignition of oily cloths in the closet.

One common comment from church people in reply to recommendations for improvements is "God will watch over us." If the conversation reaches a spiritual level quote from First Corinthians, 3:13, "Every man's work shall be made manifest: for the day shall declare it, because it shall be revealed by fire; and the fire shall try every man's work of what sort it is."

Lethbridge Herald

Lethbridge, Alta., Jan. 15, 1953. This loss illustrates the importance of good housekeeping. Fire is believed to have originated by spontaneous ignition of oily rags in the basement janitor's closet. One thousand parishioners were left without a meeting place.

Two Cigarette Fires — Different Results

Two cigarette fires which illustrate the importance of fire safety in dwelling construction have recently been reported. In one case fire spread was augmented by light combustible materials; in the other case, fire spread was halted by an effective assembly of noncombustible materials over wood framing. In neither case was there loss of life or serious property damage but some of the most valuable fire protection lessons can be learned from such incidents where destruction is not total.

San Antonio Housing Project

Joe Bacon

No. 1. General exterior view of apartments damaged by cigarette fire.

One-quarter inch plywood partitions and doors in an eight-unit apartment house built by the Federal Housing Authority in San Antonio, Texas contributed to the spread of a fire which might have been confined to one unit instead of damaging three apartments.

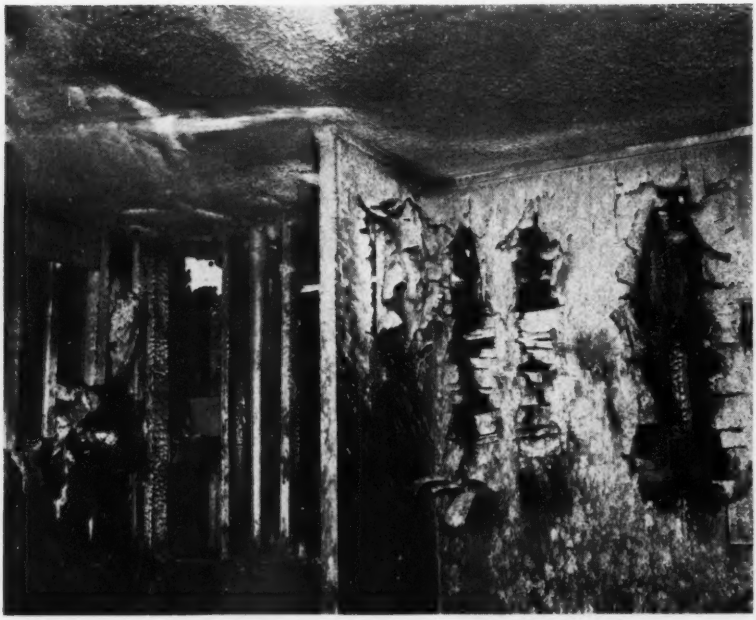
San Antonio Fire Marshal

No. 2. Fire originated in this couch. Wall shown is only concrete block wall in area involved and was an exterior wall.

It is presumed that the fire started when a spark from a cigarette was dropped on the studio couch. (See Photo No. 2.) The apartment was unoccupied when a passer-by telephoned the alarm at 12:50 A.M. As firemen arrived they found the entire apart-

Joe Bacon

No. 3. Plywood partitions totally destroyed in stairwell.



Joe Bacon

No. 4. Contrasts in behavior of structural materials subject to fire damage under these typical conditions is well illustrated here. Note how plywood failed and delaminated while plaster on gypsum lath ceiling withstood heat and flame and is only smudged. This fire in an eight-unit apartment house in San Antonio started in a couch from a cigarette.

ment involved, indicating delayed detection. Three persons, all smokers, had been in the apartment within an hour of the time the fire was discovered.

The extent of the damage is evident in Photos Nos. 1, 3 and 4. The one-quarter inch plywood partitions and doors burned quickly and the fire spread vertical to the upstairs apartments through the plywood lined stairwell and to the adjoining ground apartment through the thin combustible partitions. By way of contrast it can also be noted in Photo No. 4 that the ceiling construction, which was plaster on gypsum lath, withstood the attack of heat and flame until the fire department extinguished the blaze.

It is reported by San Antonio Fire Marshal G. W. Fulbright that following this fire, 5/8ths inch gypsum wallboard is being substituted for the 1/4 inch plywood on both sides of the wood studs in partition walls, with the concealed spaces filled with mineral wool batting. Doors are being provided with an additional panel and are being painted with flame retardant paint on both sides. Stairways are being lined with 5/8ths inch gypsum board and all exposed wood likewise treated with fire retardant paint.

The building loss due to this fire was estimated at $8,000 with the sound value of the entire eight-unit apartment estimated at $51,000, minus contents.

Courtesy Wiltse & Company

No. 5. Dwelling was not damaged although serious fire involved an automobile in the garage and burned out redwood siding and much of the framing. Gypsum lath and plaster wall plus effective fire department operations protected the sleeping occupants in the 4:05 A.M. fire.

Los Angeles Garage Fire

A 4:05 A.M. alarm brought Los Angeles Fire Department equipment to a dwelling at 6457 Riggs Place in that city. Delayed detection was again evident to fire fighters who found, on arrival, that a private car in the residential garage was seriously involved and flames had spread to the rest of the garage, roof, side and front walls. Investigators believe that the fire was caused by careless disposal of a cigarette igniting the seat cushion of the passenger car.

The rear wall of the garage (shown in Photo No. 5) was gypsum lath and plaster. The fire department reports that the "plastered wall . . . was a contribution in holding the fire loss to the garage." No damage was sustained to the living quarters although it can be readily observed that the two-car garage, constructed of redwood siding on wood framing, was destroyed. The occupants were asleep until awakened by a patrolman.

Second Prize in the Third Annual Fire Foto Contest was won by Jim Moore of the *Portland* (Maine) *Press Herald* (Rockland District Office) for this view of conflagration which hit Rockland, Dec. 12, 1952 (see January 1953 *Quarterly*, page 228). (4 x 5 Speed Graphic, 1/25, f.4.5, Dupont 428).

Fire Fotos — Contest Results

One criterion for a news photo is its ability to tell its own story. Few pictures tell more vividly or have more vivid stories to tell than fire pictures.

In its effort to collect, use and disseminate all available facts about fire, the National Fire Protection Association is encouraging news photographers to "get in where it's hot" for the inside story on fire through an annual Fire Foto of the Year Contest. Besides actual fire scenes, photographs of anything to do with fire are eligible: aftermath, human interest, fire prevention. All contribute to the over-all picture the NFPA must have to fulfill its mission.

In this article twenty-five of the top photos submitted in the third annual Fire Foto of the Year Contest are reproduced. Conducted by the NFPA, the contest is jointly sponsored by the National Press Photographers' Association and the NFPA. It is open to all *press* photographers in the United States and Canada and is judged in one class: fire connected pictures, following a point system devised by the NPPA. The judges for the third annual Fire Foto of the Year Contest were: Harold Blumenfeld, Newspicture Editor, *United Press Associations;* Joseph Costa, *King Features* and Chairman of the Board of NPPA; William C. Eckenberg, *New York Times;* Melvin R. Freeman, NFPA Public Relations Manager; and Norris Harkness, President of the Photographic Society of America.

The first three pictures (frontispiece, opposite and next page) won first, second and third prize, respectively, in the contest just concluded. 26-year-old Herb Carleton, *Van Nuys* (Calif.) *News* photographer, won first prize of $250 for his picture "PANIC" taken at the exact instant when the world's largest sound stage collapsed at the Warner Bros. motion picture studio fire May 16, 1952. Carleton described the situation thus: "I knew the giant sound stage sooner or later would collapse. I was standing nearby making routine shots where I thought the best shooting angle was. I saw the workers running toward me and the stage collapsing. I shot and 'ran like heck' myself to get out of the way of the falling debris. You have the evidence."

Just as spectacular were the circumstances under which Jim Moore, district reporter-photographer for the *Portland* (Me.) *Press-Herald* took his second prize ($75) photo of a million and a half dollar fire in Rockland, Me., "FIRE IN THE NIGHT." Moore's own description of the scene reads: "I was home flat in bed with grippe when word of the fire came. Over objections of my wife I threw clothes over pajamas, grabbing a makeshift camera on the way because my good one was being fixed. The old lens hadn't even been adjusted for infinity and the only way I had of making a focus was by ground glass while using a paper clip to hold the shutter open."

Bill Peery, *Rocky Mountain News* (Denver, Colo.) photographer, won third prize ($50) for his panoramic picture of a fire roaring across a 150-acre wheat field, "FIRE FANS." Peery is a frequent national photography prize-winner and won an honorable mention in the second Fire Foto of the Year Contest last year.

The captions briefly identify the pictures, both from the fire protection and photographic standpoint, but the pictures themselves tell the big story.

Bill Peery of the *Rocky Mountain News*, Denver, Col., won third prize for this photo of a 150-acre wheat stubble fire observed by two "Fire Fans." (4 x 5 Speed Graphic, 1/100, f.16, Panchro Press.) The fire occurred Aug. 2, 1952 northeast of Denver city limits.

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Bob Bain of the *Fort Worth* (Tex.) *Star-Telegram* was awarded Honorable Mention for this picture which he captioned "Death of a Giant." The fire, occurring August 4, 1952, was reported in the January 1953 *Quarterly* (page 238). (4 x 5 Speed Graphic, 1/50, f.8, heavy, dull overcast day, Super Panchro Press, Type B film.)

Honorable Mention was given to Bud Kamenish of the *Louisville* (Ky.) *Courier-Journal and Times* for this scene of the hasty evacuation of the Kentucky State Fair grandstand following outbreak of fire on Sept. 11, 1952. (4 x 5 Speed Graphic, 1/200, f.8, Super Panchro Press, Type B film.)

George Bertonz, photographer for the *Southtown Economist* (Chicago, Ill.) took this picture showing firemen attaching the first hose lines to fight a fire in the General Furniture Company retail store in Chicago on December 29, 1952. Two customers and four employees died in this fire to make it one of the most important U. S. retail store tragedies of recent years.

The reasons for the sudden origin of the fire in the second story are not clear with the only theory that it started in a concealed space above the ceiling and was undetected until it burst through an ornamental sheet metal covering.

Open stairwells spread heated gases and smoke quickly throughout the building. One employee on the third floor, two in a balcony office and one employee and two customers in an elevator were asphyxiated. The elevator stopped 30 inches from the first floor level, trapping the three victims within. Elevator power failure is believed to have resulted from the fire originating in the second story ceiling. (4 x 5 Speed Graphic, 1/50, f.8, Super Ortho Press.)

Indianapolis (Ind.) *Times* Staff Photographer William A. Oates, Jr. took this photo of the Goldstein Bros. Furniture Warehouse fire that occurred January 7, 1953. A fire wall saved the adjoining Severin Hotel. (Speed Graphic, 5 sec. exposure, f.4.7, Super Pan Press.)

Bob Noble, Staff Photographer, *New York Herald Tribune* snapped this picture of a typical multiple occupancy mercantile building fire that occurred in New York City on November 10, 1952. (4 x 5 Speed Graphic, 1/200, f.8, Super Panchro Press.)

Laban H. Whittaker, Jr., of the *Quincy* (Mass.) *Patriot Ledger*, titled this entry "Will They Never Learn." It shows Captain Edward Columbus carrying William F. Macado, 15, from the basement of a tire store in Quincy on June 3, 1952. The boy, along with a 13-year-old companion, was trapped in the basement while trying to extinguish a fire originating there. (4 x 5 Speed Graphic, 1/400, f.11, Type B film, G.E. No. 5 bulb.)

The Coventry (Ohio) Township fire department lost this pumper while fighting a boathouse fire on October 27, 1952. A quick shift of the wind ignited the hose bed. The photo was an entry of John Neitz, *Akron* (O.) *Beacon-Journal*. (1/100, f.16, Super Panchro Press, Type B.)

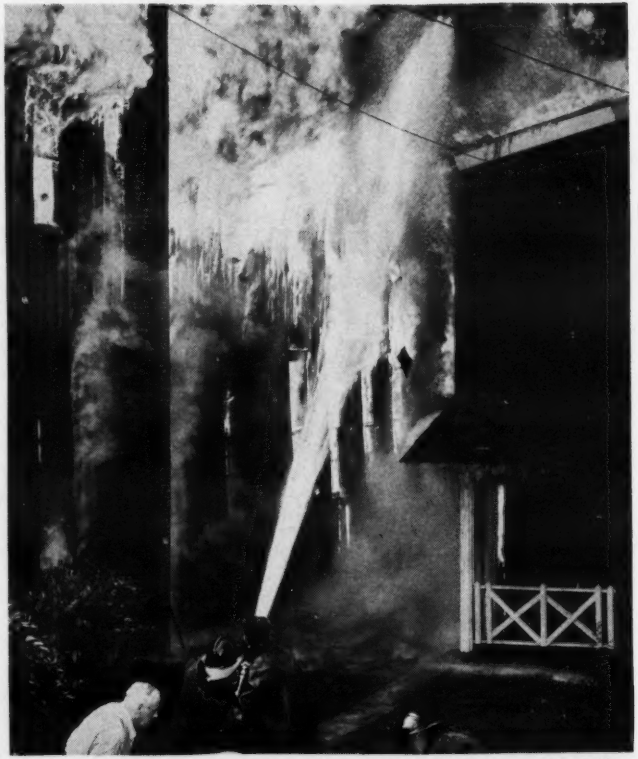
Perry Mason of the *Waterloo* (Ia.) *Daily Courier* (now with the *Rock Island Argus*) took this photo of the ice coated aerial truck during the January 27, 1952, fire in Waterloo, Iowa, which destroyed the Dotson Clothing Company store (see January 1953 *Quarterly*, page 225). Photo taken with a 4 x 5 Speed Graphic (1/25, f.8, Super Panchro Press, Type B, No. 11 bulb.)

The Logan Dickie barn in West Hartford, N. H. was destroyed by a fire which broke out without warning at 10:55 A.M. At least a dozen Jersey calves were led from the flaming building. Fortunately most of the herd were at pasture when the fire started. Bill McAllister of the *Valley News* (Lebanon, N. H.) took this photo on August 12, 1952. (Speed Graphic, 1/50, f.8, Super Ortho film—rainy day.)

Florian P. Klasinski of the *Stevens Point* (Wisc.) *Daily Journal* took this photo May 10, 1952. The owner of the dwelling being consumed by fire stands dejectedly with the few pieces of furniture which were saved. (4 x 5 Speed Graphic, 1/10, f.8, Super Panchro Press, Type B.)

The Borough of Hawley, Pa. sustained this spreading fire which leveled four homes and the Borough Building on October 18, 1952. A fire truck housed in the Borough Building (center of photo) was destroyed and evidence indicates that the blaze originated in or near its garage. This view was photographed by Robert F. Jenkins, *The Scranton* (Pa.) *Times*. (4 x 5 Crown Graphic, 1/25, f.16, Type B film.)

A serious fire fighting problem confronted the Shreveport (La.) Fire Department on January 17, 1953, as this photo by Langston McEachern *(Shreveport Times)* illustrates. Baled paper had been moved into the building contrary to fire department regulations for this type storage. (4 x 5 Graphic, 1/60, f.11.)



Paul R. Schell of the *News Tribune*, Beaver Falls, Pa., captions this photo "Futile Effort." Firemen vainly tried to prevent the spread of fire from the burning warehouse (left) to the frame apartment building (right). The fire occurred July 2, 1952. (4 x 5 Speed Graphic, 1/100, f.11, Super Panchro Press film Type B, G.E. No. 6 flash bulb.)

This Moorhead, Minn. Super Oil Company fire of September 5, 1952 gave Cal Olson of the *Fargo* (N. D.) *Forum* the opportunity to make this unusual shot. Mr. Olson reports that he "moved in close, shut my eyes, and tripped the shutter just as the oil went up in a hot puff." The fire started when the driver of a tank truck moved the truck forward without disconnecting the hose. (4 x 5 Speed Graphic, 1/200, f.8, Super Pan Press, Type B.)

LIFE magazine published this photo by Clarence B. Garrett of *The Sun Papers* (Baltimore, Md.) showing the tanker *F. L. Hayes* burning following collision with a 6,000-ton freighter in the Delaware Canal, May 15, 1952. (4 x 5 Speed Graphic, 1/10, f.11, Super Pan Press, Type B.) See January 1953 *Quarterly*, page 243.

Dean Conger of the *Denver* (Colo.) *Post* took this photo of the mile-wide forest fire on Mount Evans from an Air Force SA-16 amphibian on September 20, 1952. The fire was out of control at the time the photo was snapped and a severe timber loss resulted. (Rolleiflex, 1/500, f.8, Plus X film.)

Ray E. White of the *Quincy Herald* (Quincy, Ill.) took this photo of a fireman doing an unwelcome chore. (Speed Graphic, 1/100, f.8, Gevaert Gevapan film.)

Two Manchester, Conn. firemen reviving a dog. (4 x 5 Speed Graphic, G.E. No. 5 bulb, f.11, Dupont 428.) Photographer: Herman F. Marshall, *Hartford* (Conn.) *Courant*.

This unusual photo by Fred Cheuvront, Staff Photographer, *Los Angeles* (Calif.) *Mirror* was taken during a Fire Prevention Week demonstration at the St. Ambrose School in Los Angeles. The photographer took the picture from the tower of an adjoining church. (4 x 5 Speed Graphic, 1/100, f.22.)

1952. (4 x 5 Speed Graphic, 1/10, f.11, Super Pan Press, Type B.) See January 1953 *Quarterly*, page 243.

snapped and a severe timber loss resulted. (Rolleiflex, 1/500, f.8, Plus X film.)

This unusual fire in Minneapolis on June 13, 1952, was photographed by Wayne Bell, Chief Photographer of the *Minneapolis* (Minn.) *Star and Tribune*. The fire was caused by a 4,000-volt power line which was blown across the car during a storm that day; all four occupants escaped without injury. (4 x 5 Speed Graphic, 1/10, f.6.3, Panchro Press, Type B film.)

Robert J. Anderson of the *Jamestown* (N. Y.) *Post-Journal* took this photo of a salvage warehouse fire on Oct. 24, 1952 in Jamestown. He captioned it "The Walls Come Tumbling Down." The photo was taken with a 4 x 5 Speed Graphic (1/50, f.11) on Super Panchro Press, Type B film.

This photograph was made during a Fire Prevention Week demonstration in October 1952, by Curtis Barnes of the *Rochester* (N. Y.) *Times Union*. The test fire involved a pile of phosphorus which created this unusual scene. (4 x 5 Speed Graphic, 1/25, f.4.5, Super Ortho Press film.)

Dansk Brandværns-Komite
(The Danish Fire Prevention Committee)

By H. Cortsen-Moller, Civil Engineer

The Danish Fire Prevention Committee is an independent institution founded in 1920 to obtain and circulate information for establishing proper safeguards against loss of life and property caused by fire.

The Committee consists of 63 members appointed by the Ministry of Justice and other authorities, including police and fire brigades, the large trade organizations, insurance companies, the Federation of Danish Industries, the Danish Employers' Confederation, the Danish Federation of Trade Unions, the great agricultural organizations, the Institution of Danish Civil Engineers, and others.

The direction of the Committee is in a Board of Directors. At present, the president is Mr. Aage Svendsen, the former Chief of the Department of Justice; vice-president is Mr. A. H. Torp-Pedersen, General Manager of the Insurance Company for Provincial Towns.

As in the NFPA, different technical committees are appointed to deal with special matters, such as organization of fire prevention and protection in cities and in rural districts, technical advice to industrial firms through inspection, fire testing, rules on oil burner installations, storing and handling of flammable liquids and like matters.

The work is carried out by an executive office staff, Mr. H. Hoeg, Managing Director, assisted by 14 civil engineers, one adviser, seven clerks and a press secretary.

Inspections of Industrial Plants

Since the Committee was founded in 1920, its main efforts have been the prevention of industrial fires by giving technical advice to industrial firms through inspections. Unlike the situation elsewhere, where the inspection of industrial plants and like properties is carried out by fire protection engineers from the insurance companies, such inspections in Denmark are carried out by the civil engineers from the Danish Fire Prevention Committee in accordance with a voluntary agreement between the factories and the Committee.

The inspection-visits, the duration of which may vary from one hour to four days, take place four times a year. The whole factory is gone through, and advice is given concerning the measures for preventing outbreak and spreading of fire.

Even if the advice given is of technical character, the Committee attaches much importance to the psychological effect of the inspection. The Committee has no authority to demand that safeguards be carried out and we do not want to have such authority. The engineers endeavor to convince the factory leadership that the advice given is based on experiences gathered through many years from a very great number of different factories partly in Denmark and partly in foreign countries, and that the advice is reasonable and exclusively given to assist the factory in establishing the best possible precautions against interruption of production due to fire.

Factory managers often ask the Committee to pass on plans for buildings to be erected, and in that way valuable precautionary measures in many cases are obtained. A quarterly publication, "Brandværn i Virksomheder" ("Fire Prevention

in Industry") is sent to the inspected firms and to the interested insurance companies.

The factories pay a fee for the inspection. As the Committee is a non-profit institution, the fees, however, are set only high enough to assure that income from the inspection work just covers the operating costs in connection with it. The inspected factories obtain 5 per cent reduction of the fire insurance premium (for buildings, contents and loss of profits) if the engineer after every inspection can certify that the fire extinguishers, equipment and the fire doors are in perfect order. To obtain this premium credit, the factories are not obliged to follow the advice given by the engineers. The experience shows, however, that mainly the advice is followed. At the beginning of this year 774 factories and other properties were under inspection. The sum insured for these works amounts to about 8 billion Danish crowns (1.1 billion dollars). The indemnity paid in relation to the premium for the last 28 years has been only 43 per cent.

Public Education

A great deal of the Committee work has the object of educating the public in fire prevention through press, radio and exhibitions. Decisions and penalties regarding fires caused by negligence are published monthly based on material from the fire investigations of the police. Special campaigns take place at the seasons of harvest, stove heating, Christmas trees, freezing weather, and at other times.

In the schools lessons are given in fire prevention. As the damage due to fires in farm buildings is rather high here in Denmark (about 50-60 per cent of the total fire losses), special importance is attached to this type of property.

During the period of recovery after the war, in which years the fire losses in industry and the handicrafts were rather severe, the Committee promoted efforts to cut down these losses by establishing a more intimate cooperation with the Danish Employers' Confederation and the Danish Federation of Trade Unions. In 1947 they agreed upon the establishing of cooperative committees. A number of pamphlets, posters and articles in trade journals have been issued.

Cooperation with Other Fire Organizations

The Danish Fire Prevention Committee for about 30 years has cooperated closely with its opposite organizations in Sweden ("Svenska Brandskyddsföreningen"), Norway ("Norsk Brandvern Forening"), and Finland ("Brandskyddsföreningen i Finland") through regular meetings and conferences and exchange of experiences. In 1950 a Scandinavian Presidium was founded by the above-named four organizations to obtain further intimate cooperation as to fire technical research, fire testing, classification of building materials and construction, literature references, education in fire prevention and protection in technical schools and like subjects of common concern.

The Committee has also been in touch with other European fire prevention organizations such as those of the United Kingdom ("The Fire Protection Association"), France ("Comité Technique International de Prévention et d'Extinction du Feu"), Switzerland ("Brand-Verhütungs-Dienst für Industrie und Gewerbe"), and others.

For 30 years the Committee has been a member of the National Fire Protection Association and has taken advantage of American experience through the publications received from the NFPA.

Fire Protection For Chemicals — Part 2*

By Charles W. Bahme

EDITOR'S NOTE: The following article is the second installment of a manuscript prepared by Mr. Bahme for class instruction in fire protection engineering and for the training of members of the fire service charged with responsibility of safeguarding life and property against the fire and explosion hazards of dangerous chemicals. It should also be valuable reference material for the industries concerned with the manufacture, storage and transportation of chemicals, fire prevention authorities and others concerned with life and property safety.

Rather than delay publication until the manuscript could be published as a unit, the NFPA is making the information available by serial publication in the *Quarterly*. Readers are invited to submit their comments to the NFPA Executive Office.

The recommendations in this article are those of the author and do not necessarily reflect the official recommendations of the National Fire Protection Association, the U. S. Navy or the Los Angeles Fire Department.

Data on General Classes of Chemicals (Continued)

Esters

Esters, sometimes referred to as ethereal salts, are organic salts formed from an alcohol and an acid. Most esters are practically colorless flammable liquids. Because of their characteristic pleasant, fruity odors, many esters are used in the preparation of synthetic perfumes and flavors, *e.g.*, ethyl butyrate (rose odor), butyl butyrate (pineapple odor), isobutyl formate (raspberry odor). The esters, ethyl acetate and butyl acetate are the most important of all the solvents used in lacquers.

Ethyl silicate, another common ester, is used in the preparation of weatherproof, acidproof mortar and cement, since it deposits silica on hydrolysis and aids in preserving stone, brick, concrete and plaster. Paints made with ethyl silicate are extremely resistant to heat and chemical fumes, and do not darken on aging.

Fire Hazards of Esters

All esters are flammable although the degree of hazard differs greatly among members of the class. Flash points of several common esters are listed in Table 6.

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*Part 1 was published in the April 1952 *Quarterly*, pp. 323-346.

Some esters, such as methyl acetate (CH_3COOCH_3), are highly flammable. Methyl acetate is a clear, colorless, volatile liquid with a fragrant odor. It is moderately soluble in water, with a flash point of 14°F., boiling point of 140°F., vapor density 2.56, explosive range 4 to 14 per cent, ignition temperature 850°F., and specific gravity 0.9. It is a solvent for cellulose nitrate and for paints, varnishes, lacquers, etc.

Methyl benzoate (Niobe oil, $CH_3COOC_6H_5$) is a clear, colorless liquid with an odor like wintergreen, flash point of 181°F., specific gravity 1.093, and is very slightly soluble in water. It is used in perfumes, soaps and pharmaceuticals.

Another example is amyl acetate ($CH_3COOC_5H_{11}$) with a flash point of 77°F., boiling point 300°F., specific gravity 0.879, and vapor density 4.49. It is slightly soluble in water. Amyl acetate is used as a solvent in the manufacture of pyroxylin lacquers, patent leather, metallic paints, art glass, perfumes, flavors, etc.

Fire Fighting—Esters

Carbon dioxide, dry chemical, vaporizing liquid (carton tetrachloride), water spray and ordinary foam (in most cases) are suitable for fires involving esters. "Alcohol" foam is required in the case of methyl acetate, ethyl acetate and other esters soluble in water.

Ethers

Ethers are a group of organic compounds derived from alcohols by replacing the hydrogen of the hydroxyl group (OH) with another radical. They are practically colorless liquids, with characteristic odor. Their chemical formulas are characterized by having two of the same or different hydrocarbon radicals (e.g. CH_3, C_2H_5, C_6H_5, etc.) joined by an oxygen atom. For example, the formula for methyl ethyl ether is $CH_3OC_2H_5$.

Ethers range in physical form from gaseous to solid, with most being liquids. They are less soluble in water than the alcohols. The lower members of the ether series (methyl ether, ethyl ether, propyl ether, etc.) are more volatile than their corresponding alcohols.

When mixed with alcohols, ethers are used in the manufacture of collodion, photographic film, and smokeless powder. Certain ethers are being widely used as agricultural insecticides and industrial fumigants, owing to their highly toxic effect on insects; for example, dichlorethyl ether, in dilute oil or water solutions, is used as a soil fumigant.

The cyclic ethers, which are frequently referred to as "oxides," (e.g. ethylene oxide, propylene oxide) react with water, alcohols, amines and other compounds having an unstable hydrogen atom, to form quite a number of industrially important chemicals. Table 7 gives the properties of some of the ethers and oxides.

Hazards of Ethers

Ethers and oxides have a considerable range of toxicity, with most having definite anesthetic properties.

Ethers are generally more volatile and flammable than the alcohols and have a wider explosive range. Their heavy vapors may travel quite a distance to a source of ignition and flash back. Because containers of ethers can build up considerable vapor pressure when heated, they should be kept in cool locations. The NFPA Recommended Safe Practice for Hospital Operating Rooms[7] should be observed with respect to the use of ether (diethyl ether) in operating rooms. (See also **Anesthetics.***)

*See first installment of "Fire Protection for Chemicals," published in the April, 1952 NFPA *Quarterly*.

Table 6

Properties of Typical Esters*

	Flash Point (a)	Specific Gravity (b) (Water=1)	Boiling Point (a)	Vapor Pressure (mm. Hg) (b)	Water Solubility (% by wt.) (b)	Lbs. per Gal. (b)
Ethyl Acetate	24	0.90	171	65.0	8.7	7.51
Isopropyl Acetate	40	0.87	194	47.5	2.9	7.27
Butyl Acetate	72	0.88	260	8.7	0.68	7.34
Methyl "Cellosolve" Acetate	140 (oc)	1.01	289	3.3	Complete	8.38
Methyl Amyl Acetate	110 (oc)	0.86	295	3.8	0.13	7.15
"Cellosolve" Acetate	150 (oc)	0.97	313	1.2	23	8.11
Ethylbutyl Acetate	130 (oc)	0.88	324	1.8	0.06 (25°)	7.33
Ethylhexyl Acetate	190 (oc)	0.87	389	0.4	<0.03	7.27
"Carbitol" Acetate	230 (oc)	1.01	424	0.1	Complete	8.42
Butyl "Carbitol" Acetate	240 (oc)	0.98	475	0.04	6.5	8.16
Glycol Diacetate	220 (oc)	1.10	375	0.3	16.4	9.21
Methoxytriglycol Acetate	260 (oc)	1.09	471	...	Complete	9.17
Glycol Diformate	200 (oc)	1.23	351	0.5	Decomp.	10.22
Diethyl Sulfate	220 (oc)	1.18	Decomp.	0.1	0.7	9.82
Methyl Acetoacetate	170 (oc)	1.08	341	0.7	44.5	8.98
Ethyl Acetoacetate	184 (oc)	1.03	359	0.8	11.6	8.54
Ethyl Silicate	125 (oc)	0.94	334	1.0	Decomp.	7.79

(a) All temperatures are Fahrenheit. (b) Determined at 68°F. (oc) Open cup determinations.

*Most of the data in this table were obtained from "Synthetic Organic Chemicals," published by Carbide and Carbon Chemicals Corporation.

Table 7

Table 7

Properties of Typical Ethers and Oxides*

Ether	Flash Point (a)	Ignition Temperature (a)	Explosive Range (c)	Vapor Density	Specific Gravity (b)	Boiling Pt. (a)	Vapor Pressure (mm. Hg.) (b)	Solubility (% by wt.) (b)	Lbs. per Gal. (b)	Toxicity PPM (d)
Diethyl Ether (Ether)	—49	356	1.8–36.5	2.5	0.71	95	442	slightly	5.95	400
Diisopropyl Ether	—18	830	.....	3.52	0.73	156	119	no	6.03	...
Dibutyl Ether	77	382	.....	4.48	0.77	286	4.8	no	6.40	...
Dihexyl Ether	170 (oc)	...	.....	6.43	0.79	440	0.07	no	6.61	...
Diethyl "Cellosolve"	95 (oc)	406	.....	...	0.84	251	9.4	yes	7.01	...
Diethyl "Carbitol"	160 (oc)	...	.....	...	0.91	372	0.4	yes	7.56	...
Dimethoxy Tetraglycol	285 (oc)	...	.....	...	1.01	528	<0.01	yes	8.43	...
Dichlorethyl Ether	185 (oc)	696	.....	4.93	1.22	353	0.7	no	10.17	15
Dichlorethyl Formal	230 (oc)	...	.....	5.90	1.23	424	0.1	no	10.3	...
Dichlorisopropyl Ether	185 (oc)	...	.....	...	1.11	369	0.1	no	9.27	...
Triglycol Dichloride	250 (oc)	...	.....	...	1.20	466	0.03	no	9.97	...
Ethylene Oxide	<0	804	3.0–80.0	1.52	0.88	51	1095	yes	7.25	100
Propylene Oxide	—35	...	2.1–21.5	2.00	0.86	93	445	yes	6.91	...
Dioxane	54	356	2.0–22.0	3.03	1.04	214	29.0	yes	8.62	100

(a) All temperatures are Fahrenheit. (b) Determined at 68°F. (c) Explosive range is percent by volume in air. (d) Toxicity is based on an eight-hour exposure period in parts per million. (oc) Open cup determinations.

*Some of the data in this table were obtained from "Synthetic Organic Chemicals," published by Carbide and Carbon Chemicals Corporation.

Schwartz[14] asserts that nitric ether explodes when heated, and that nitrous ether (ethyl nitrite) is liable to explode spontaneously in storage.

Most ethers will ignite spontaneously when in contact with the per-acids.

The health and fire hazards, together with recommended safeguards for handling ethyl ether are well covered in Chemical Safety Data Sheet SD-29.[3]

Ethers—Peroxide Formation

The following is quoted from an article dealing with ether hazards,[15] "All ethers which we have studied have been found to form peroxides in storage and with practically all, explosions have been experienced. Diethyl ether, ethyl tertiary butyl, ethyl tertiary amyl, and disopropyl ethers are very dangerous. The methyl tertiary butyl, methyl tertiary amyl and methyl tertiar hexyl ethers are less so, and, so far as our experience goes, may be distilled without appreciable danger, even after several years storage.

"Dimethallyl ether forms peroxides more rapidly than any other ether we know, but is unique in that the peroxide formed is destroyed without danger at the boiling point of the ether."

No ether should be dry distilled unless peroxides have been proven absent. Even a trace of peroxide may be dangerous since it becomes concentrated in the still residues. It is now the practice to never distill ethers to dryness except on the safe side of a shatterproof screen, for "when explosions occur, they are usually extremely violent. We have seen thick glass vessels neatly punctured at several yards range by flying splinters from a thin walled distillation flask."[16]

It has been claimed that various substances will inhibit the formation of peroxide and thus make the use of the ether safe. According to another source,[16] sodium amalgam was found to be the best inhibitor after also testing copper, mercury, copper-mercury, and copper-zinc; storage in amber bottles delayed the peroxide formation, but none of the above was completely successful. The article also stated that salicylic acid was not effective as an inhibitor with diisopropyl ether, and recommended that no inhibitors be trusted completely; tests should always first be made, such as the titanic acid test, for qualitative analysis, or ferrous thiocyanate method for a quantitative test. Merely putting a copper wire in the bottle will inhibit but not prevent the formation of these spontaneously explosive peroxides.

It was recently asserted, however, that the stabilization of ether by means of sodium amalgam is neither safe nor practical, for USP ether ordinarily contains about 0.5 per cent water and 2 per cent alcohol, both of which react with sodium amalgam to form hydrogen which might burst a closed container. It was concluded that the use of any one of the numerous patented inhibitors, or copper or iron along with storage in metal or opaque amber glass containers provides a sufficient stability for all practical purposes.*

Chemical Safety Data Sheet SD-29[3] recommends the addition of five square feet of No. 40 mesh copper wire for each 1,000 gallons of tank volume, or the use of certain other products which have an inhibiting effect on the formation of peroxides. Recent developments have indicated that the addition of water for peroxide removal is probably the least efficient method.

Pure dry ether stored under laboratory conditions in a colorless bottle will develop

*Based on information received by the author from Thos. L. Jacobs, Associate Professor of Organic Chemistry, University of California at Los Angeles, March 3, 1949.

detectable amounts of peroxide in one month. Light seems to be a more important factor than heat, but another reference[37] states that even in amber bottles in a dark place, such peroxides may be formed. Ether sealed in tin cans copper plated or otherwise inhibited is not likely to form peroxides. Acetaldehyde, a product of the spontaneous decomposition of ether, acts as a catalyst to cause a progressive increase in the rate of peroxidation.

The strong oxidizing properties which ether acquires on long standing have been attributed to hydrogen peroxide or to "ethyl peroxide."[37]

According to Schwartz,[14] when ether has formed sufficient peroxides, it may explode spontaneously, or on violent shock. Although this contention is denied by modern chemists with reference to ethyl ether, it may account for the reluctance of some commercial users to buy up old stocks of isopropyl and other ethers which have been stored in "surplus" warehouses for several years. The supposed risk in handling the drums and destroying the peroxides may outweigh whatever economic advantages such a prospect may hold forth.

Fire Fighting—Ethers

Because of the wide explosive range of diethyl ether (1.8 to 36.5 per cent in air) and low ignition temperature (356°F.), fires in diethyl ether are more difficult to combat than fires in gasoline, and the danger of "flash-back" is much greater.

According to recent tests, ether fires can be most effectively extinguished by the use of extinguishers which dispel a dry chemical powder. Carbon dioxide is also recommended, and carbon tetrachloride is effective on fires involving limited amounts of ether.

Water can be effectively used to cool exposed drums, and fog can provide cover protection for fire fighters. Also, water may tend to reduce the flammability of water-miscible ethers by dilution.

It is recommended that fires in ether flowing under pressure not be extinguished unless, by so doing, the source of supply can be shut off. Continuing discharge of the unburned liquid, which is readily vaporized, may create a fire and explosion hazard much greater than the hazard of the burning ether.

Fluorides

Fluorides are salts of hydrofluoric acid. For example, sodium fluoride (NaF), appears in the form of colorless crystals; it is soluble in water, used as a reagent for blood, as an antifermentative in the brewing industry, medicinally as an antiseptic, as a food preservative, and a rat poison. Inorganic fluorides are noncombustible but are *poisonous.*

Fluorocarbons

Fluorocarbons are fluorinated hydrocarbons in which the hydrogen is replaced by fluorine. Saturated fluorocarbons are said to be the most stable organic compounds known. They are nonflammable, but may break down when exposed to flame to yield carbon and tetrafluoromethane (CF_4).[20]

Although some investigators have indicated that fluorocarbons are generally nontoxic, it is recommended that due precaution be exercised in their use and handling, as the physiological properties of some of these compounds have not been fully studied.

They have a wide boiling range. For example, tetrafluoromethane gas (CF_4) has a boiling point of —198°F. and 1,2-dibromo-2,2-difluoroethane has a boiling point of 200°F.

Although not in extensive use at present, they have been utilized as refrigerants for

Table 8

Properties of Typical Fumigants

Name	Chemical Symbol	Form	Flash Point (a)	Ign. Temp. (a)	Explosive Range (b)	Sp. Gr. Water=1	Vapor Den.	Boiling Point (a)	Tox. ppm. (c)	Haz. Conc. (d)	Water Soluble
Carbon Disulfide	CS_2	Liq.	—22	212	1-50	1.3	2.64	114	20	1.5	No
Carbon Dioxide	CO_2	Gas	Nonflammable			1.05	1.53	—108	5000	...	Yes
Carbon Monoxide	CO	Gas	...	1204	12.5-74.2	...	0.97	—314	100	4	No
Carbon Tetrachloride	CCl_4	Liq.	Nonflammable			1.58	5.32	170	50	...	No
Chloropicrin (e)	CCl_3NO_2	Liq.	...	...		1.65	5.69	233	...	...	No
Cyanide of Calcium	$Ca(CN)_2$	Sol.	Yields Hydrocyanic acid gas when wet or exposed to air							Poison	Yes
Cyanide of Potassium	KCN	Sol.	Yields Hydrocyanic acid gas when wet or exposed to air							Poison	Yes
Cyanide of Sodium	NaCN	Sol.	Yields Hydrocyanic acid gas when wet or exposed to air							Poison	Yes
1, 1-Dichloro-1-nitroethane	$CCl_2NO_2CH_3$	Liq.	168	...	...	1.4	4.9	255	10	...	No
Ethylene Dibromide (e)	CH_2BrCH_2Br	Liq.	Nonflammable			2.17	6.48	269	100	...	No
Ethylene Dichloride	CH_2ClCH_2Cl	Liq.	56	775	6.2-15.9	1.26	3.42	183	75	12.5	No
Ethylene Oxide	CH_2OCH_2	Liq.	<0	804	3-80	0.88	1.5	51	100	3.8	Yes
Formaldehyde (37 per cent)	HCHO	Liq.	130	806	7.0-73	...	1.03	...	10	...	Yes
Hexachlorocyclohexane	$C_6H_6Cl_6$	Sol.	...	...	...	1.87	...	Decomp.	...	...	No
Hydrocyanic Acid	HCN	Liq.	0	1000	6-40	0.69	0.9	79	20	4	Yes
Methyl Bromide	CH_3Br	Liq.	Pract. non-flammable	999	13.5-14.5	1.7	3.27	40	80	19.45	No
Methyl Formate	$HCOOCH_3$	Liq.	—2	840	4.5-22.7	0.97	2.07	90	400	14.3	Yes
Naphthalene	$C_{10}H_8$	Sol.	176	1038	0.9-5.9	1.15	4.42	424	100	...	No
Paradichlorobenzene	$C_6H_4Cl_2$	Sol.	150	...	...	1.45	5.07	345	75	...	No
Propylene Dichloride	$CH_3CHClCH_2Cl$	Liq.	60	1035	3.4-14.5	1.15	3.89	205	75	8.3	No
Sulfur Dioxide	SO_2	Gas	Nonflammable			...	...	1.43	14	10	...	Yes

(a) All temperatures are Fahrenheit.
(b) Explosive range is per cent by volume in air.
(c) Toxicity data, based on recommendations of California Division of Industrial Safety, are maximum allowable concentrations in parts per million in air for an eight-hour exposure period.
(d) Hazardous concentration, shown as pounds of chemical per 1000 cubic feet to produce lower explosive limit.
(e) Usually extended with flammable thinners.

some time and may soon be put to various other uses such as impellents for turbines, anesthetics, insulation media and as fire extinguishing agents.*

Formates

Formates are the salts of formic acid (HCOON). Sodium formate (HCOONa), for example, is a slightly hygroscopic, odorless, crystalline powder which is soluble in water, and used as a reagent for arsenic and phosphorus and as an antiseptic. It is usually formed by heating carbon dioxide and sodium hydroxide together under pressure. Formates are generally nonhazardous.

Fulminates

Fulminates — from the Latin word *fulmen* — "lightning flash or thunderbolt", are a group of explosive compounds used to detonate high explosives.

Fulminating caps, frequently containing mercury fulminate, are small devices used to explode the charge of shells, grenades, etc. There are two kinds of fulminates.

The fulminates from fulminic acid are extremely dangerous even in a moist state or under water. They can be detonated by impact, shock, friction, heat, flames, electric spark or acids. They cannot usually be heated as high as 212°F., and because of their sensitivity are not practical to use.

The fulminates used for primary explosives are formed by precipitating solutions of gold, silver, platinum, etc., with ammonia, and contain no carbon, and hence should not be confused with the fulminates which are salts of fulminic acid (HONC), discussed in the preceding paragraph.

When wet, fulminates are classed by the ICC[20] as "explosives", under "Initiating explosives". When dry, the transportation of fulminate of mercury, for example, is prohibited.

Fulminate of mercury is a brown crystalline powder, prepared by reacting a solution of mercury in nitric acid with alcohol. It must be kept covered with water and away from brass and copper. A four-pound weight dropped two inches will detonate it, as will also a temperature of about 419°F. for five seconds.

Fulminate of silver has properties similar to fulminate of mercury. In mirror resilvering, explosions have occurred from solutions involving the use of silver compounds and ammonia. It is stated that fulminate of silver is liable to be produced by the action of ammonia on silver oxide, especially in a warm room, and therefore all solutions should be thrown away as soon as the silvering operation is completed.[27] The used solutions may be poured into a large jar, and some common salt added, which causes the silver to be recovered.

Davis[28] states that the black material which deposits in a reagent bottle of ammoniacal silver nitrate, and which sometimes collects on the rim and around the stopper, contains fulminate of silver and has caused explosions when the glass stopper has been carelessly turned.

Fumigants

Fumigants are gases, liquids or solids from which a toxic gas or vapor is produced for the purpose of exterminating harmful organisms. Recommendations for the control of fumigation hazards have been published by the National Fire Protection Association.[29]

Table 8 gives the properties of typical fumigants. Table 9 lists the dosage which, according to the California Department of Agriculture Bulletin of September 3, 1937, seemed to cause a complete "kill" in grains. Note the comparison between the amounts used and the amounts which are necessary to reach the lower explosive limits.

*See October 1951 *Quarterly*, pages 110-131.

Table 9

Concentrations Employed—Fumigants

Fumigant	Lbs. per 1000 cu. ft. used in fumigation tests	Lbs. per 1000 cu. ft. to reach lower explosive limit
Hydrocyanic acid (from sodium cyanide)	3.5 (NaCN)	8
Hydrocyanic acid (from Discoids)	4 (HCN)	4
Chloropicrin	2	Unk.
Carbon disulfide	12	1½
Ethylene oxide and ethylene dichloride	9.5	Unk.
Ethylene dichloride and carbon tetrachloride	17	Unk.
Ethylene dichloride	14	12.5
Methyl bromide	1	19.4

Since we do not know what proportions were used in some mixtures (*e.g.*, ethylene dichloride and carbon tetrachloride as shown in Table 9) we cannot estimate their flammability. It must be determined to what extent some nonflammable fumigants are diluted with flammable liquids. Generally speaking, an 80 per cent dilution of a flammable liquid with CCl_4 (carbon tetrachloride) renders it relatively safe for awhile. Upon standing in the open, however, such mixtures are apt again to become dangerous, especially if the CCl_4 has a lower boiling point and higher vapor pressure than the flammable liquid. If CCl_4 has a higher boiling point, the flammable vapor is likely all to evaporate first. Where, however, the liquids have approximately the same boiling point, or form an azeotropic solution, this danger is minimized.

Fumigant—Carbon Disulfide

Carbon disulfide (CS_2) is a heavy colorless liquid with an offensive odor, having an ignition temperature so low that its vapor can be ignited from a steam pipe or a light bulb. It also has a very low flash point, –22°F., and a wide explosive range, 1 to 50 per cent in air. Its boiling point is 114°F., and vapor density 2.64. It is not miscible with water, and is heavier, so that it will go to the bottom if poured in a tub of water. It is also quite toxic, and according to the California Division of Industrial Safety, a continual exposure to 20 ppm is dangerous. Products of combustion contain sulfur dioxide which in concentration of 0.2 per cent by volume in air may cause serious injury in one-half hour or less.[29]

It is inert to most metals, ceramics and glass, and is completely stable in steel vessels. It is shipped in steel tank cars and drums.

It should only be pumped by water pressure and should be stored in steel tanks over concrete basins containing water, or in drums using a water seal where practicable.

Carbon disulfide is insensitive to shock as long as no oxygen is present, and therefore, except when in original containers, should be kept blanketed with inert gas or water at all times. It is endothermic, and its vapors may be exploded by a blow of a hammer or sudden fracture of the container.

When burning, the flames are almost colorless, and the flame temperatures relatively low. In fighting a fire where CS_2 is involved, dry powder, CO_2 and inert gases may be useful if water spray is used to cool everything below 212°F. to avoid a reflash. Cooling and blanketing with water may be possible in open tanks. Foam and carbon tetrachloride are not effective.

Firemen should wear respiratory protection where this substance is present, for not only are the vapors poisonous, but also the products of combustion which include sulfur dioxide and carbon monoxide. Avoid direct contact with the skin.

It has been reported by certain chemical supply houses that when the plugs were removed from drums of carbon disulfide which had been stored in the sun, flames shot into the air as a result of spontaneous ignition of the vapors which escaped under heavy pressure.

Fumigant—Ethylene Oxide

Ethylene oxide (CH_2OCH_2) is a colorless, highly volatile liquid with an ether-like odor. It is an anesthetic, has a toxic threshold of 100 ppm, and is suffocating even in low concentrations. It is also highly flammable, having a flashpoint of less than zero, an explosive range of 3 to 80 per cent in air, an ignition temperature of 804°F., a boiling point of 51°F., specific gravity of 0.88, and a vapor density of 1.5. An explosive mixture is created when 3.8 pounds are mixed in 1000 cu. ft. of air. Ethylene oxide must be properly inhibited to prevent explosion, as it is unstable. Cylinders of ethylene oxide have been known to explode spontaneously.

It has been alleged that a mixture of one part ethylene oxide and nine parts CO_2 makes a safe fumigant. According to one publication, such a mixture is used as an all-round fumigant in doses of 10 to 15 pounds per 1000 cu. ft. at temperatures above 70°F. for a 12-hour exposure.[37] The U.S.D.A. says such a mixture is nonexplosive and not highly toxic to man, and leaves no appreciable odor, although it will injure beans or seeds for planting.[38] An expert fumigator conducted outside tests on such a mixture, using an even greater ratio than 9 parts CO_2 to one part ethylene oxide, and he found that it was still flammable.

Fumigant—Carbon Tetrachloride

Carbon tetrachloride (CCl_4) is a colorless liquid with a peculiar odor, and has very heavy vapors (vapor density 5.32)—over five times heavier than air. It is nonflammable but poisonous. Its vapors have caused the deaths of many persons who have used it for a cleaning solvent in apparent ignorance of the fact that it is also used as a lethal fumigant.

Fire fighters have long been warned that the vapors of CCl_4 will produce toxic gases, such as phosgene, hydrochloric acid, etc., when used as a fire extinguishing agent in contact with flames.* One reference states that a quinone is added to the amount of 2 per cent to fluids used in fire extinguishers to prevent formation of phosgene from CCl_4.[30] Fire fighters may not have been aware, however, that the vapors themselves are toxic in concentrations of 50 ppm for a continued exposure, indicating that these vapors are more dangerous than those of chloroform which have a toxic threshold of 100 ppm (as classed by the California Division of Industrial Safety).

Carbon tetrachloride is capable of explosion in contact with aluminum powder, and the usual mixture of CCl_4 and chloroform found in fire extinguisher fluids in contact with sodium can be exploded by a blow of a hammer.[31]

The following case is of interest to fire fighters. A laboratory technician tried to put out a wax fire with CCl_4. When the liquid hit the wax, a flash explosion occurred which caused him serious burns. In technical circles, the nature of such an explosion is described as "a catalyzed reaction between the halogenated hydrocarbon and the ethylenic unsaturation in the presence of a peroxide." All the conditions would be met in the reaction between the burning wax and the CCl_4, since the wax contains a good number of ethylenic unsaturated linkages and peroxides form by atmospheric oxidation.[32]

Fumigant—Methyl Bromide

Methyl bromide (CH_3Br or MeBr) is an odorless liquid at temperatures below 40°F. and a gas at ordinary temperatures. It has an ignition temperature of around

*This has been asserted in many publications, including those of the Manufacturing Chemists' Association.

999°F., but has such a narrow explosive range (13.5 to 14.5 per cent in air), and burns so feebly even when within that range, that for all practical purposes it may be considered nonflammable.[23]

It would take about 19 lbs. of MeBr diffused in 1000 cu. ft. of air to reach the lower flammability limit, and the maximum dosage likely to be used would not exceed 3 lbs. per 1000 cu. ft. or 1.2 per cent by volume. It is generally applied in the dosage of 1 lb. per 1000 cu. ft.

Although MeBr is not corrosive to most metals, it attacks aluminum and aluminum alloys with the formation of the spontaneously flammable aluminum trimethyl. See Safety Data Sheet SD-35.[3]

Methyl bromide is transported in small cylinders and tin cans, and the latter have been know to rust in storage and release their contents. In addition to fumigation, it has been used in aircraft fire extinguishing systems.* But owing to its toxicity and the number of deaths reported to have occurred from its use as a portable first aid fire appliance many cities, including Los Angeles, have prohibited the sale or use of portable methyl bromide fire extinguishers.

The New York State Department of Labor's publication, Monthly Review, June, 1948, Vol. 27, No. 6 states that the methyl bromide gas enters the body primarily through inhalation, but as evidenced by the death of two men wearing self-contained breathing apparatus, fatal cases have been reported from skin absorption.

Even with self-contained breathing apparatus, firemen who must enter atmospheres where MeBr cylinders have been leaking, or where fumigation is under way, should remain no longer than is necessary to effect a rescue or to provide ventilation. The ordinary all-purpose gas mask should not be used. MeBr has no strong odor, and is not irritating, and therefore will not cause a man to seek fresh air, as in the case of ammonia, sulfur dioxide or chlorine.

A halide detector, several types of which are on the market, is the easiest and most useful means of determining the presence of harmful concentrations of MeBr gas.

*See October 1946 NFPA *Quarterly*, pages 109-113.

Fumigant—Hydrocyanic Acid

Often used in conjunction with MeBr in the fumigation of large flour mills, or by itself, is the well known fumigant, hydrocyanic acid (HCN), also called prussic acid. Table 8 sets forth most of its physical properties, but a few additional points should be mentioned.

It is colorless and practically odorless (although an almond fragrance is sometimes noticeable). It is a liquid below 79°F., at atmospheric pressure. It is very poisonous and has a low flash point (0°F.). In gaseous form, it is slightly lighter than air (vapor density 0.9) with an explosive range of about 6 to 40 per cent in air, and an ignition temperature of about 1000°F.

HCN in commercial use is stabilized by the addition of small amounts of certain acids to prevent its polymerization or "decomposition". Should such a reaction take place, the heat generated would be great enough to cause the liberated gases to reach a pressure of more than 1000 psi, with possible violent rupture of the vessel. According to the manufacturers, this is not likely to happen under normal storage conditions for periods up to a year and possibly many years.

Research reports have also been studied[24] which assert that HCN is a high explosive with a power approaching that of nitroglycerine but that it is relatively nonbrisant and requires a strong initial primer

for detonation. However, according to its manufacturers, the danger of accidental explosion of stabilized HCN is either nonexistent or so remote that it creates no problem. Its lethal and flammable vapors are probably of major concern to fire fighters.

It is transported in steel cylinders, which for safety and other reasons, the suppliers require to be returned within 90 days, whether the contents have been used or not. It also is transported in specially designed drums to agricultural areas for use in fumigation of orchards and field picking boxes. In so doing, these drums (some of which have relief valves set to open at 7 psi internal pressure) are kept covered with wet sacks or ice, to keep the liquid from vaporizing while enroute to the storage point in the agricultural areas. There, they are usually kept under open-air, noncombustible canopies, with a fine spray of water kept on them during hot weather. In Los Angeles, storage areas for such drums are located at least 200 feet from inhabited buildings, 500 feet from schools, sanitariums, etc., and not over 700 gallons is allowed in one location.

Safeguards must be established to prevent unauthorized tampering, and a suitable place, preferably outside of the building in a locked, fenced enclosure, should be used. The fire department should be informed when such cylinders arrive on the premises so that in case a fire breaks out in the building, adequate precautions may be taken.

Absorbed liquid HCN is also used in the form of small thin discs about ¼-inch thick and less than ½-foot diameter, consisting of a porous material which soaks up the HCN. These discs (or "discoids") are packed in tin cans holding up to 14 lbs. water capacity (but containing not over ⅓ of a lb. of HCN for each lb. of water capacity). The usual sizes are 16 and 40 ounces (net HCN content). Where these units are evenly distributed, there is little likelihood of an explosive mixture being concentrated in any one subdivision of the building as in the case of HCN discharged from a hose nozzle. This does not mean that there is no fire hazard, however, for fires have been reported when a source of ignition has been present.

Hydrocyanic acid gas is also generated for fumigation by dropping cyanide "eggs" in specially designed pressure vessels containing sulfuric acid solution, from which the gas is conducted through tubes to the point of fumigation. Sometimes the "egg" is merely dropped in an open pot of sulfuric acid which is placed in the room to be fumigated. The gas can also be produced by scattering a mixture of calcium cyanide and inert powder in the premises. The manufacturer of "cyanogas" powder states that it contains approximately 25 per cent available HCN which is slowly liberated upon exposure to air when the material is spread out over a wide area. The use of such material in quantities of about 4 lbs. per 1000 cu. ft. of space to be fumigated, would create an atmosphere less than 25 per cent of HCN's lower explosive limit.

In summary, although HCN is flammable, its use has long been found desirable for controlling a great variety of pests, and has the advantage of quick diffusion (being lighter than air) and ready dissipation after ventilating operations are commenced. It also gives a faster "kill" than most fumigants, and leaves no residual odor. In the hands of competent experts who adhere to good practice regulations such as those embodied in the NFPA Model Fumigation Ordinance,[35] it can undoubtedly be used without creating an unreasonable risk to operators or the public.

Fumigant—Atomized Solvents

Another form of fumigation which has attracted the attention of the fire service recently, is the atomization of solutions containing pyrethrum, DDT, etc., in a flammable solvent having the characteristics of kerosene.

A new type of vaporizer machine is reported in use in the garment industry to kill moths, and in large food markets to kill flies. It employs an electrically heated water jacket, to cause a high flash point (150°F.) flammable liquid containing the fumigant to be converted into a gas. As the flammable vapor is released it is diluted with about 54 per cent steam. The manufacturer of the device states that the flammable vapor-steam mixture is nonflammable. A timing device on the unit to shut it off after a given interval of operation permits the building occupant to turn it on and go home for the night.

Many instances have occurred where a passerby observed the fumigant fog through the glass windows and, thinking it was smoke, turned in a fire alarm. Fire companies responding have had to investigate the alarm, requiring forcible entry into the premises.

Needless damage would be averted if these fogging devices were placed in plain view in front of the window, or if a card were hung on the front door to indicate that a steam fumigant was being released.

A method which caused an explosion in a house in northern California, employed a gun designed to heat the liquid as it passed through, and could be adjusted so as to completely oxidize the solvent and inject the products of combustion (smoke and gases bearing the insecticide) into the building. In the case in question, it was reported that the temperature of the "gun" was not hot enough to burn the liquid, and that the solvent in a vapor-cloud form was shot into the building where it probably hit a pilot light flame and caused the explosion of the vapor-air mixture.

In this connection it should be remembered that no matter how high the flash point of a liquid, if it is dispersed in the air in microscopic particles (atomized), it can be exploded if an ignition source exists.

While most atomized sprays do not create the toxic risk that poison gases do, they do create a fire risk if proper safeguards are not taken.

Fumigant—Dry Powders

All organic dusts will burn, and if dispersed as a cloud in the air and ignited, the dust will explode. Obviously a dust explosion is not recommended as an insecticide. However, one case was reported of a cook who had long been tossing a handful of flour in the air and igniting it with a paper torch, causing a quick demise for all the flies in his cookshack. Then one day he was so successful he even killed the flies in the messhall, when the ensuing explosion blew out the intervening partition (and also all the windows).

Fumigant—Pyrethrum

Pyrethrum, made from the powdered flower heads of several variations of Chrysanthemums, is a common dusting powder used for cockroaches, ant powder, etc. It is sometimes dispersed in the air with a bellows device, and instances of explosions have been reported where such dust clouds have come in contact with an open flame, burning the operator. Sulfur dust, also used in pest control, is likewise flammable.

Fumigant—DDT

Dichloro-diphenyl-trichlorethane is a white, odorless powder of remarkable insecticidal properties. It is not flammable as a dust, owing to the number of chlorine

atoms in the composition and the fact that it is used in about a 1 to 5 per cent mixture with talc or other inert materials, but it is often mixed with a flammable solvent. It is moderately toxic to humans when taken by mouth, or when breathed in dust form. However, the dust is not absorbed and not irritating to the skin, but in solution, especially if the vehicle is readily absorbed by the skin, is definitely toxic.

Storage of Fumigants

In general, it should be readily apparent that cylinders or tin cans of poisonous gases should not be stored inside a building except in a specially designed toxic-gas storage room. Drums of HCN should only be stored out-of-doors under open canopies, and all yard storage of poison gases (or liquids which yield poison gases) should be well separated from inhabited buildings. If they are stored in a room or under cover, only fire-resistive construction should be allowed. Automatic sprinkler protection is desirable for any location where fire may break out and expose containers of poisonous fumes or gases.

Fire Fighting—Fumigants

One of two situations are apt to face any fire fighter who arrives in response to an emergency call at a building which is under fumigation:

1. A man has been overcome inside, or
2. A fire has broken out inside.

In the first situation, if the gas used is very lethal, or if the victim has been inside very long, he is undoubtedly dead already, and there is no point in needlessly jeopardizing other men's lives for the sake of retrieving a corpse. Expert fumigators say they will not step into a high concentration of HCN, for instance, even with a mask on, because of its rapid absorption through the skin, and they certainly would never attempt to effect a rescue by merely holding the breath and trying to make a quick dash into the building to get a man — even in a light concentration. Their best advice to firemen, where lethal gases are present in a sealed building, is to first open up the building from the outside (using self-contained breathing apparatus) and ventilate it thoroughly before entering. Here is a quotation from instructions which some fumigation companies issue to their crews: "Never open a door into, or enter, a gas-tight room in which more than a trace of HCN would be free, without wearing an adequate gas mask while testing the atmosphere of the room with a methyl-orange-mercuric chloride test paper."

If the fumigation of the building has just started, or if aeration has commenced, the operators will be present with their gas masks, test-papers, mechanical ventilation machines, and special first-aid kits. If the operators are not on the premises, an emergency number will appear on the warning sign. Have the operators called. Listen to their advice in the matter.

In the second situation mentioned — a fire in the building under fumigation—the toxicity, flammability and solubility of the fumigant are of major importance.

1. TOXICITY.

The toxicity aspects have already been discussed from a rescue standpoint, but it should also be pointed out that poison gases which are soluble in water will form poisonous solutions, and care should be exercised when overhauling debris contaminated by such poisons, to avoid any skin contact.

2. FLAMMABILITY.

The question of flammability is really most important from the fire prevention standpoint. If the poison gas has already burned up when the firemen arrive, it will

offer no health hazard, and if it has not burned, but exploded, the gas will probably be gone also. In the reported cases involving such incidents, there was no trace of the poison gas around after the explosion and fire. However, a partially empty cylinder may still be intact, in which case it should be shut off if possible by men wearing self-contained oxygen masks. Where a leaking cylinder cannot be shut off or plugged, the use of water fog may be helpful in absorbing or dispersing the gas. If the cylinder has been subjected to fire temperatures, it could be cooled off with hose streams but it should not be disturbed until it has thoroughly cooled, and then only after consulting with the supplier (where this is possible).

If a cylinder of poison gas is found burning at the valve, let it burn but keep it cool and protect exposures. This is safer than extinguishing it and allowing the poison gas to diffuse into the neighborhood.

3. SOLUBILITY.

In addition to toxicity and flammability, the third factor of importance to firemen regarding fumigants is *solubility:*

Soluble *gases,* such as HCN, sulfur dioxide, etc., can be partially removed from the atmosphere with fog nozzles or water spray.

Soluble *solids,* such as the various cyanides and cyanide preparations (*e.g.,* "cyanogas") give off toxic and flammable HCN when wetted, and also create poisonous solutions that should not be waded in, and which should be kept off the skin during overhauling operations. (See **Cyanides**).†

Soluble *liquids* which are poisonous, if they have been spilled, can be diluted with large volumes of water and washed into drains with copious amounts of water.

Gases‡

Hazards

Any gas can be dangerous. Even compressed air can violently burst its container if exposed to a hot fire. The same is true of carbon dioxide, as was demonstrated in one fire in a life raft laboratory. In the latter case, the sudden rise in temperature from the hot fire caused some of the cylinders to blow into fragments because the rupture discs failed to provide a quick enough release for the high pressures developed.

There are numerous cases on record in which valve assemblies of cylinders of carbon dioxide, oxygen, and air were broken when the cylinders were knocked over or dropped, thereby causing the cylinders to take off through the air like jet-propelled missiles, sometimes causing fatal injuries.

Gases can be flammable, like hydrogen, or poisonous like sulfur dioxide and methyl bromide; or both flammable and poisonous like ammonia and hydrogen sulfide; or both flammable and subject to spontaneous explosion, like acetylene. Gases can be poisonous, flammable, and also subject to detonation, like hydrocyanic acid gas; or be poisonous and capable of burning up the

†See first excerpt of Mr. Bahme's article published in April 1952 *Quarterly.*

‡Many dangerous gases are treated elsewhere in this study. For data on gases used in fumigation, see **Fumigants.** Included are carbon monoxide, carbon dioxide, ethylene oxide, hydrocyanic acid, methyl bromide, sulfur dioxide, etc.

With respect to gases used in refrigeration, *e.g.,* ammonia, methyl chloride, sulfur dioxide, freon, etc., see **Refrigerants.*** For a discussion of chlorine and fluorine see **Halogens***; see also **Chlorinated Hydrocarbons**†** for data on chloroform, methyl chloride, certain freons, etc. Butane and propane are covered under **Liquefied Petroleum Gases.*** See **Anesthetics**†** for data on ethylene, ethyl chloride, chloroform, cyclopropane, nitrous oxide, propylene, oxygen, helium, etc.

*To be included in a future installment of Mr. Bahme's text.

cylinder, like fluorine; or capable of supporting combustion, like oxygen and nitrous oxide. They can be both poisonous and capable of supporting combustion, like chlorine and nitrogen dioxide (nitric oxide).

Gases which are classed as poisonous by the ICC, such as hydrocyanic acid, do not usually have soft plugs in the cylinders. However, some poison gases, such as chlorine and sulfur dioxide, are treated by the ICC as being in the same class as compressed air, and hence such cylinders bear the Green Label and have soft plugs. Another poison gas, ammonia, also bears the Green Label, but the smaller portable cylinders do not have soft plugs.

Storage—Gases

The important point to remember as far as storage is concerned, is that gases which support combustion must be kept entirely apart from gases which will burn. Hence, chlorine, fluorine, nitrogen dioxide, nitrous oxide, nitrogen tetroxide, oxygen, compressed air, etc., must never be stored with flammable gases, such as ammonia, hydrogen, acetylene and hydrogen sulfide. It does not matter in which of these two storage areas you place inert gases, such as helium, argon and neon, nor other nonflammable gases (whether poisonous or not), such as sulfur dioxide, methylene chloride, carbon dioxide and freon.

As a general rule, no gas cylinder should ever be stored among combustible materials where it may be subjected to the heat of a fire. Nor should flammable or toxic gases ever be stored in basements where they may jeopardize the lives of firemen responding to a fire in that area.

It is nearly always preferable to store flammable and poisonous gases outside of any building, in a shaded enclosure which, though it might only be a strong wire fence, can be well secured against tampering by unauthorized persons.

Fire Fighting—Gases

Detailed suggestions for fighting fires where certain types of gases may be involved, such as liquefied petroleum gas, chlorine and acetylene will be found under the discussion of the specific gas in this and other parts, but the general principles of such procedures can be briefly summarized as follows:

1. Find out *what* gas is involved.
2. Wear appropriate breathing apparatus where toxic gases are present.
3. Approach from the windward where possible.
4. Evacuate people from the leeward first where the type of gas requires.
5. If a flammable gas is present but has not yet ignited, take necessary precautions to protect working party from a flash fire, through use of covering fog streams, shields, etc., and take steps to prevent ignition. (There may be a situation, however, where it will be advisable to stand back and ignite the gas, rather than to allow it to flow uncontrolled over an extensive and hazardous area.)
6. If the gas is soluble in water, such as ammonia or sulfur dioxide, and the use of water will not cause serious damage, then fog streams can be effectively used to help clear a path to the location where a shut-off can be made.
7. If the gas is already burning it is generally best not to extinguish the flames until it is certain that a shut-off can be effected. Protection of exposures until the fuel is consumed is sometimes the only course of action available. (There may be times when it is desirable to extinguish a burning gas jet rather than to allow it to propagate back into the cylinder, such as is brought out elsewhere in the discussions on **hydrogen** and **acetylene.**)

Gases—Hydrogen

Hydrogen is the lightest gas known, is colorless, odorless, and highly flammable. It has a vapor density of .069, an ignition temperature of 1085°F., an explosive range of 4.1 to 74.2, and a boiling point –422°F. It is non-toxic but suffocating in a confined space.

The addition of 16.5 parts nitrogen or 10.2 parts carbon dioxide to one part hydrogen is said to render it nonflammable. In exactly equal proportions it is spontaneously explosive with chlorine in the sun or artificial light.

Usually a leaking high-pressure joint in a hydrogen system takes fire immediately. There are many cases reported of spontaneous ignition of hydrogen leaking from cylinders. When a tightly closed valve of a hydrogen cylinder is opened rather suddenly, immediate ignition of the gas at the orifice has occurred. Various reasons have been given for this action. One theory is that electrical charges produced on small dust particles or minute droplets of moisture by friction, ignite the hydrogen-air mixture as it leaves the vessel.

Storage battery charging rooms sometimes build up as high as 5.3 per cent hydrogen in the air if not properly ventilated. Several explosions have been attributed to this condition.

Hydrogen is now commonly employed as a coolant in large generators, owing to its low wind resistance and high conductivity. When hydrogen escapes under pressure it usually ignites and there is danger of suck-back of the flames into the holder, especially if the temperature of the holder is reduced by hose streams.

Gases—Oxygen

Oxygen is a nonflammable gas, but a strong supporter of combustion. It is shipped in steel cylinders at a pressure of about 1,875 psi at normal temperatures and has a pressure of 2,300 psi at 130°F. It is tasteless, odorless, colorless, and slightly heavier than air. One pound of the gas will occupy about 11.2 cu. ft.

Oxygen Handling and Storage

Oxygen creates violent explosions when mixed with oil or other flammable liquids under pressure. Explosions have occurred when oxygen cylinders were mistaken for nitrogen and the gas was introduced into hydraulic lines. Oil, grease, etc., should be kept away from the valves and regulators of oxygen equipment.

Oxygen cylinders should never be used for the storage of any other gas, even temporarily.

Another hazard is in the filling of oxygen cylinders. Most plants now use distilled water as the only lubricant for the oxygen compressors owing to the fact that explosions have occurred where glycerine or similar lubricants had been used.

An oxygen cylinder rupture has been reported that was due to a crack in the cylinder wall. Apparently the crack had occurred when letters were impressed in the cylinder. The regular testing of such cylinders in accordance with ICC requirements (every five years) will help to eliminate cylinders when they have become dangerously weakened.

In order to avoid the danger of forming explosive atmospheres in storage areas, oxygen cylinders should be stored well away from any flammable gases. Where an adequate distance separation cannot be had, then a fire-resistive barrier of a gas tight nature should be erected to separate them.

Oxygen cylinders have a combination frangible disc and fusible element which releases at about 167°F. In one instance where an oxygen cylinder had been stored on a vehicle under a canvas tarpaulin, the

sun's heat caused sufficient temperature rise to fuse the soft plug. The blast of oxygen ignited the canvas and burned up the top of the cylinder.

If dropped, and the valve assembly is knocked off, the cylinder may be propelled by the escaping gas under high pressure.

Oxygen Hazard During a Fire

Cylinders of compressed oxygen, when involved in a fire, may explode if subjected to sudden and intense heat, or if a flame impinges upon a portion of the cylinder. In the former case, the soft plug may not have time to fuse, or even if it does, the venting capacity may be insufficient to take care of high pressure created by the expanding gas. Where a flame impinges upon a cylinder in one spot, the metal becomes softened and the cylinder swells at that point until the steel becomes so thin that it breaks.

Any combustible materials in the vicinity of the escaping oxygen will burn intensely and greatly increase the task of extinguishing the fire.

Gases—Acetylene

Unlike ordinary compressed gas cylinders, acetylene cylinders have a porous filler made of asbestos, balsa wood, or preferably, a monolithic filler composed of a mixture of cement, asbestos, diatomaceous earth, and charcoal. The latter type of filler is poured into the cylinder and then baked. Although it looks completely solid it is actually about 80 per cent air space. Acetone which is put into the filler absorbs about 25 times its own volume of acetylene for each atmosphere of pressure. Therefore, at 17 atmospheres or 250 psi (the normal pressure for the cylinder) the acetylene capacity is about 425 times the volume of the acetone.

The ordinary sized cylinder found around welding shops holds about 5½ gallons of acetone (about 43 pounds) and about 20 pounds of acetylene gas. Thus, it takes an overall package weight of about 200 pounds to transport about 20 pounds of acetylene gas, and yet if the filler and the acetone were not inside the cylinder, only a very small quantity of the gas could be put into the container. This is due to the fact that acetylene is an endothermic compound which (unless dissolved) becomes unstable at pressures about 15 psi, and is subject to detonation by shock. While it is true that in the manufacture of dissolved acetylene the gas is compressed to as high as 400 psi, it is contained in moist pipes of small diameter designed to withstand explosion pressures of several thousand psi, so that if spontaneous decomposition should occur, no damage is done.

Acetylene Decomposition

Although acetylene is subject to decomposition at 15 psi, this decomposition cannot proceed with explosive force through an opening smaller than five thousandths of an inch, and part of the function of the filler in the cylinder is to confine any spontaneous decomposition inside the microscopic cells and to absorb the heat created. Thus if such action should take place inside a container having a filler in good condition the cylinder is not likely to explode. If, however, the filler is of inferior type, or has been damaged through severe mistreatment of the cylinder, the decomposition may proceed slowly until it reaches a void where the remaining gas violently decomposes. Actually, acetylene cylinders are supposed to be constructed and filled so as to be capable of passing rugged ICC tests involving bullet and thermit penetration, bonfire, and dynamite charge, and still

maintain the filler in such a condition as to resist explosive "dissociation". Although the vast majority of such containers will give years of safe service, it is not easy for a fireman to look at a cylinder and be able to determine whether or not the inside filler is in good condition.

Acetylene Hazards

In addition to its tendency to decompose at elevated pressures acetylene is also highly flammable, having an explosive range wider than most gases (2.5 to 82 per cent). It has an ignition temperature of 635°F. and a vapor density of 0.9. Acetylene forms highly sensitive explosive compounds with silver, copper and certain other metals, and will spontaneously explode when diffused in chlorine in the presence of light.

All acetylene cylinders are equipped with soft plugs designed to fuse at about 212°F., and there will usually be three or four on both the top and the bottom. On the very small cylinder, a plug may be in the valve assembly as well as on the bottom. The soft plugs of cylinders standing in the hot sun have been blown out by the increased vapor pressure of the acetone, with ensuing fire. Regardless of the precautions exercised, occasionally a fire breaks out around the cylinder valve or a loose soft plug. Should a fire occur around the valve or regulator, the heat may cause a fusible plug on top to blow out with a loud bang, and a roaring jet of white flame will extend ten or twelve feet in the air (depending upon the pressure in the cylinder and how full it is). The refrigerating effect on the acetone caused by the rapid discharge of the gas will cause the flame to diminish in fifteen or twenty minutes to a yellowish flame perhaps two or three feet in length. Frost will appear on the bottom of the cylinder.

It is conceded by the experts in the acetylene field that at this stage of the fire there is a possibility of the flame gradually being reduced to a small size and then propagating back into the cylinder. While there is no oxygen inside to support combustion, the gas can "dissociate" into its component parts of hydrogen and carbon, with the heat from the invisible hydrogen flame issuing from the opening, and the action may proceed throughout the cylinder—slowly if the filler is of good type and condition, or explosively if otherwise. From a study of such fires reported to the Dangerous Chemicals Detail of the Los Angeles Fire Department[22] from both Naval and Municipal fire departments, it was learned that when such action takes place the cylinder gets hotter and hotter, even to the point of becoming cherry red at the point where decomposition is taking place inside. A frying or hissing noise will be heard, and the paint will be burning off the cylinder. An invisible hydrogen flame will be issuing from the opening. Even though this action takes place, local experience has demonstrated that where the cylinder was kept cool by securing 1½-in. fog nozzles in such a manner as to envelop the container, no explosion resulted. As soon as the fog was shut off, the cylinder heated up to a cherry red again, and if this were permitted to continue, the metal would be so weakened that the internal pressure would blow the cylinder open.

Fire Fighting—Acetylene

If one were to ask the average workman what he would do if he noticed a fire burning around the top of the acetylene cylinder he was using, he might reply that he would shut off his equipment, call the fire department, notify the people in the building to clear out, and then attempt to extinguish or control the fire. Yes, he *might*, if he

were well indoctrinated in emergency procedures, but the chances are he would give the common answer, "Why, I'd just run like hell!" If he had the presence of mind to quickly extinguish any small leak around a fusible plug or valve, using a glove, heavy cloth or wet waste, or by slapping a piece of putty around the leak, he could then take the cylinder outside and while letting the gas slowly diffuse into the air, prepare a tag to indicate that the cylinder was defective, and notify the supplier to come and pick it up. But if he were slow to grasp the situation, it would not be long until the radiated and deflected heat from the small flame would cause a soft plug to let go with a loud noise, and the ensuing roaring jet of luminescent flame might readily ignite any exposed combustible materials. After the soft plugs have blown out, nothing can be gained by attempting to close the acetylene cylinder valve, but closing the oxygen cylinder valve (if one is next to it) would be a good thing. When the fire department arrives, it may find that an oxygen cylinder is chained alongside the cylinder of acetylene. Unless fog streams are immediately used to keep the set-up cool, the soft plugs on the oxygen container may be next to go, thereby creating a large blow torch. If the vent opening for the oxygen is not large enough to let the terrific pressure escape rapidly enough, the cylinder may explode. While the occupants of the building are getting out, it is probably the best procedure to release the oxygen cylinder under cover of fog protection and get it away from the fire.

A fire involving an acetylene cylinder at a Los Angeles aircraft plant is a good example of how such situations should be handled. The plant fire chief, being well versed in such matters, was not only able to get the oxygen cylinder away, but had a dolly brought up to take the hot acetylene cylinder out of the building. Even with the sprinkler heads flowing and fog lines, the flames still were shooting several feet into the air. After several minutes, these subsided, and because of the possibility of backward propagation of flames into the cylinder, dry chemical was used to knock them out. Then he immediately started to take the cylinder outside on the dolly. However, it appeared that internal decomposition was already taking place, for the cylinder kept getting hotter and in one place started to get a cherry red. So the cylinder was moved well away from the building and a fog nozzle was secured in such a position that it played on the container continuously. After an hour or so the fog nozzle was shut down temporarily after which the cylinder again got hot. Subsequent checks were later made, and it was not until eleven hours later that the decomposition finally ceased.

Thus, it would seem that the best course of fire fighting where the cylinder is inside a building is to first control the fire while it is in its high pressure stage, and cover exposures. Then, when the flame has died down, extinguish it with a wad of putty, or dry chemical, and get the cylinder outside well away from the building where escaping gas will not create a hazard. Have the area posted to warn of the danger of flammable gas. Ordinarily, firemen follow the rule of never extinguishing a fire unless a shut-off can be effected, for the reason that they do not want to fill the building with flammable gas and thereby create a greater hazard. However, in the case of acetylene, especially where the soft plugs have blown, a shut-off is not easy to effect, and to allow the flame to burn at the cylinder until the gas is all gone gives rise to the added risk of backward propagation leading to in-

ternal decomposition and possible explosion. It is true that decomposition may be initiated anyway, but the chances are greatly reduced if the fire is extinguished after the first burst of high pressure flames has subsided. If the cylinder is removed quickly, the building will not become charged with gas. In any event it is not practicable to take a burning cylinder down an elevator, or through a plant having a large amount of combustibles along the route of exit.

Should the indications of internal decomposition appear — the frying noise inside, the paint burning off the cylinder, the hydrogen flame, increasing temperature of the cylinder—some experts say that the fire department's best course of action is either to get the cylinder behind a barricade or in a ditch, or else get the firemen behind a barricade or in a ditch, and remove all people from the building. If there is any doubt about whether decomposition is taking place, water can be thrown on the cylinder, and if it continues to steam, then decomposition is progressing. Even throwing the cylinder into a trough of water is not likely to stop the action at this point. It appears, however, that in a majority of cases at least, the cylinder can nevertheless be hauled or dragged outside well away from the building, and a stream of water kept on it to prevent its rupture by internal heat and pressure. Because of the unknown factor, *i.e.*, the condition of the filler, the possibility of an explosion, however remote, must be considered, for it can take place even while a hose stream is turned on the cylinder, if the decomposition should reach a large void in the filler.

If called upon to fight a fire in a building where a large number of acetylene cylinders are involved, such as at a cylinder loading rack, it is not good policy to attempt to get close enough to actually extinguish the burning jets of acetylene. Under such circumstances there are likely to be impinging jets of flame from one cylinder upon another, causing them to rupture and fly off in unpredictable directions. It would seem that the better plan is to set up deluge sets and while hitting the main body of the fire from a distance or from a shielded position, direct most of the attention to protecting exposures.

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Fire Record of Cities, 1952

As Reported by Municipal Authorities

The following tables summarize the fire experience for 1952 in cities with population over 20,000 in the United States and Canada. Of the 702 cities canvassed, 642 reported.

These statistics have been collected and published in the April QUARTERLIES since 1939 and represent a permanent reference for members who desire to determine fire experience trends within a particular city by comparing present with past experience. It is not intended that these tables be the basis of comparisons among different cities, as comparisons based on these statistics may be misleading.

Fire departments of 530 United States cities and 46 Canadian cities of over 20,000 population have reported their estimates of fire loss, fire alarms, building fires, and false alarms for 1952 to the NFPA Department of Fire Record.

A total of 560 United States cities having more than 20,000 population reported a fire loss for the year 1952 of $205,963,646. Fifty-three Canadian cities having a total population of 4,876,371 reported a total loss of $20,429,134 for 1952.

The average loss per person in the 560 U. S. cities reporting losses was $3.44, 3.6 per cent more than the $3.32 average loss in 1951. The per capita loss in the 53 Canadian cities reporting loss figures was $4.18, a 0.7 per cent increase from 1951.

The average loss per building fire in 509 U. S. cities for 1952 was $555, compared with $850 in 1951. The average loss per building fire in 50 Canadian cities was $975 in 1952 compared with $1,320 in 1951.

The total number of building fires reported by 568 U. S. cities was 268,874, an average of 4.3 fires per 1,000 population, as compared with 4.08 building fires per 1,000 population in 1951 and 4.15 in 1950. Fifty-two Canadian cities reported 17,726 building fires in 1952. The number per 1,000 population was 3.68 in 1952 as compared with 3.42 in 1951.

Automobiles fires (including trucks) reported by 559 U. S. cities totaled 79,850, an average of 1.29 fires per 1,000 population. Fifty Canadian cities reported 3,033 automobile fires, an average of 0.64 per 1,000 population.

Fire departments in 574 U. S. cities of more than 20,000 population answered 877,583 alarms in 1952. The number of alarms answered in 54 Canadian cities was 53,733.

In the United States, 563 cities of over 20,000 reported 68,402 false alarms in 1952. This was 7.8 per cent of the total calls answered. It will be noted that these are "malicious false alarms" and not just cases where smoke or steam, etc., was honestly mistaken for fire. Fifty-two Canadian cities reported 7,245 malicious false alarms, or 13.5 per cent of their total calls.

Fire departments have been very cooperative in furnishing fire loss figures. Most of the 60 nonreporting cities did not record their fire experience. In a number of cases loss figures reported are preliminary estimates.

While there are occasional discrepancies in the manner in which certain cities report losses, our questionnaire calls for the total fire loss, both insured and uninsured, and this is the figure given unless otherwise indicated. Chimney and roof fires have been included in the number of building fires. A few cities do not give a complete record, but on the whole it is believed that these figures present a reliable indication of the relative trends in city fire losses.

1952 FIRE LOSSES, CITIES OF 20,000 POPULATION AND OVER

City	Population (Last Census)	Total Loss 1952	No. Alarms 1952	No. Bldg. Fires 1952	No. Auto Fires 1952	No. Malicious False Alarms 1952	Bldg. Fires Per 1000 Population
ALABAMA							
Anniston	31,150	66,264	530	192	63	16	6.2
Bessemer	28,471	168,191c	245	115	19	5	4.0
Birmingham	298,720	1,329,670	4,503	1,393	337	307	4.7
Dothan City	21,556	162,961c	393	121	46	3	5.6
Florence	23,832	.....	...	...	...	...	...
Gadsden	55,528	106,188	711	191	46	37	3.4
Mobile	127,151	.....	1,390	579	203	104	4.5
Montgomery	195,098	345,702	1,179	444	69	81	2.3
Phenix City	23,285	.....	...	...	...	...	...
Selma	22,629	40,705	190	103	33	2	4.6
Tuscaloosa	46,364	45,030	416	175	41	22	3.8
ARIZONA							
Phoenix	105,042	366,009c	1,472	490	174	103	4.7
Tucson	45,064	85,304	833	85	71	93	1.9
ARKANSAS							
El Dorado	23,047	122,039	409	87	39	18	3.8
Fort Smith	47,864	329,076	1,309	1,231	...	31	25.6
Hot Springs (e)	29,298	80,169	451	...	48	11	...
Little Rock	101,387	.....	1,990	721	194	112	7.1
North Little Rock	42,142	.....	...	...	...	...	...
Pine Bluff	37,147	87,474d	792	306	74	12	8.3
CALIFORNIA							
Alameda	63,425	90,559	915	237	53	83	3.7
Alhambra	51,284	32,132	406	45	65	56	0.9
Arcadia	23,041	53,415	306	72	14	7	3.1
Bakersfield	34,540	295,092	1,077	163	116	97	4.7
Berkeley	113,217	148,312	1,764	464	85	79	4.1
Beverly Hills	28,915	160,528f	463	112	60	21	3.9
Burbank	78,318	5,158,624	792	266	113	6	3.4
Compton	47,893	46,402	652	121	80	11	2.5
Eureka	22,913	62,660	241	121	15	18	5.3
Fresno	90,618	276,166	798	206	125	94	2.3
Glendale	95,398	95,610	853	259	108	45	2.7
Huntington Park	29,376	29,089c	220	67	28	...	2.3
Inglewood	46,046	250,324c	433	170	69	11	3.7
Long Beach	244,072	394,093	1,960	...	...	85	...
Los Angeles	1,957,692	.....	28,529	9,281	2,603	1,867	4.7
Los Angeles County	2,193,995	3,802,835	8,027	1,867	795	999	0.9
Lynwood	25,534	19,656c	355	145	45	12	5.7
Menlo Park Fire Dist.	55,000	138,434	678	152	43	10	2.8
Monrovia	20,274	224,027	370	70	29	8	3.4
Montebello	21,754	82,062	276	206	31	0	9.5
Monterey Park	20,113	18,707	243	57	27	8	2.8
National City	21,132	12,318c	228	83	50	0	3.9
Oakland	380,576	1,048,254	5,199	1,559	...	679	4.1
Ontario	22,823	10,957	192	52	33	14	2.3
Oxnard	21,159	41,479c	125	64	25	5	3.1
Palo Alto	25,290	75,388	452	147	...	35	5.8
Pasadena	104.085	346,590c	967	336	225	88	3.2
Pomona	35,157	31,895	687	98	53	43	2.8
Redondo Beach	25,208	87,378	435	105	44	15	4.2
Redwood City	25,342	33,655	613	74	41	31	2.9
Richmond	99,218	116,424c	2,039	163	82	80	1.6

c. Building and contents only. d. Insured loss only. e. Not included in totals. f. Subject to change.

City	Population (Last Census)	Total Loss 1952	No. Alarms 1952	No. Bldg. Fires 1952	No. Auto Fires 1952	No. Malicious False Alarms 1952	Bldg. Fires Per 1000 Population
CALIFORNIA (Continued)							
Riverside	46,399	131,814c	584	138	77	17	3.0
Sacramento	135,761	398,450a, c	1,808	547	191	133	4.0
San Bernardino	62,792	235,320c	924	267	121	51	4.3
San Diego	321,485	886,614c	3,346	1,208	379	127	3.8
San Francisco (e)	760,753	.....	12,050	3,596	686	1,643	4.7
San Gabriel	20,204	19,767	147	56	18	3	2.8
San Jose	95,044	518,540c	1,175	204	91	92	2.1
San Leandro (e)	27,498	60,551	330	86	35	5	3.1
San Mateo	41,536	69,389c	539	126	46	5	3.0
Santa Ana	45,534	512,952a, c	461	150	74	11	3.3
Santa Barbara	44,764	86,764c	573	141	46	22	3.2
Santa Cruz	21,848	34,822	317	85	26	14	3.9
Santa Monica	71,299	102,223	1,193	316	103	78	4.4
South Gate	50,684	303,224	441	222	95	9	4.4
Stockton	71,660	355,398c	1,454	323	124	78	4.5
Torrance	22,206	83,477	461	87	28	1	3.9
Vallejo	23,164	41,166c	601	128	59	85	5.5
Whittier	23,866	98,921	237	59	39	2	2.5
COLORADO							
Colorado Springs	45,268	125,090	574	249	40	31	5.5
Denver (e)	412,856	2,500,000a	4,124	1,743	449	436	4.2
Greeley	21,000	15,686	228	87	31	10	4.1
Pueblo	63,561	73,913	2,730	369	129	36	5.8
CONNECTICUT							
Bridgeport	159,352	448,253	1,966	704	332	108	4.4
Bristol	35,893	33,819c	464	72	43	15	2.0
Danbury	22,424	333,188	421	191	50	9	8.5
East Hartford	29,340	94,938c	474	85	...	14	2.9
Fairfield	30,370	11,895	260	25	24	1	0.8
Greenwich	40,546	233,569	1,202	175	65	8	4.3
Hamden	29,311	22,127	594	40	38	19	1.4
Hartford	177,073	815,254c	2,601	877	356	182	5.0
Manchester	33,906	.....	...	...	...	...	...
Meriden	43,747	82,710	794	197	64	66	4.5
Middletown	29,665	30,217	227	88	48	20	3.0
Milford	26,345	182,551	655	133	45	20	5.1
New Britain	73,663	130,348c	947	213	78	32	2.9
New Haven	163,344	572,609	2,789	883	217	131	5.4
New London	30,367	107,274	628	170	74	17	5.6
Norwalk	49,458	85,904	730	216	80	34	4.4
Norwich	23,382	92,870	385	129	33	4	5.5
Stamford	73,584	.....	...	...	...	...	...
Stratford	23,620	39,425	605	112	42	3	4.7
Torrington	27,770	21,847b	285	260	4	5	9.4
Waterbury	104 242	206,735	1,738	427	105	72	4.1
West Hartford	44.401	85,866	513	177	49	8	4.0
West Haven Twp.	31,876	.....	...	...	...	...	...
DELAWARE							
Wilmington	109,907	286,602	1,571	829	169	63	7.5
DISTRICT OF COLUMBIA							
Washington, D. C.	797,670	1,931,165	10,263	2,961	817	1,141	3.7
FLORIDA							
Daytona Beach	29,254	167,101	416	119	31	12	4.1
Fort Lauderdale	40,000	69,360c	632	95	34	24	2.4
Gainesville	26,577	36,585c	212	81	22	8	3.0

a. Estimate. b. Incomplete. c. Building and contents only. e. Not included in totals.

City	Population (Last Census)	Total Loss 1952	No. Alarms 1952	No. Bldg. Fires 1952	No. Auto Fires 1952	No. Malicious False Alarms 1952	Bldg. Fires Per 1000 Population
FLORIDA (Continued)							
Jacksonville	198,800	643,440	2,275	738	163	154	3.7
Key West	21,724	19,000c	438	219	14	4	10.1
Lakeland	30,846	53,685	443	153	37	28	5.0
Miami	246,983	633,455	3,650	592	175	268	2.4
Miami Beach	45,541	.....	...	...	...	...	...
Orlando	51,826	.....	...	...	...	...	...
Panama City	26,248	1,137,975	242	173	49	12	6.6
Pensacola	43,293	104,985	478	226	44	20	5.2
St. Petersburg	95,712	106,677c, f	1,565	202	79	12	2.1
Tallahassee	27,158	75,195c	608	80	46	18	3.0
Tampa	124,073	309,493f	1,528	392	117	189	3.2
West Palm Beach	43,053	.....	...	...	...	...	...
GEORGIA							
Albany	30,987	.....	...	...	...	...	...
Athens	20,102	86,184c	89	25	47	17	1.2
Atlanta	327,090	1,362,173a	6,410	1,709	584	258	5.2
Augusta	71,507	183,510	1,234	620	190	58	8.7
Columbus	79,510	183,067c	732	388	112	59	4.9
Decatur	21,626	29,298	211	77	18	6	3.6
East Point	21,628	32,414	423	70	31	45	3.2
La Grange	24,954	106,284	439	155	73	8	6.2
Macon	70,106	476,077	755	623	75	57	8.9
Marietta	20,628	17,369	293	100	35	3	4.9
Rome	29,617	56,398c	496	58	...	13	2.0
Savannah	119,689	215,581	1,570	999	175	106	8.4
Valdosta	20,004	.....	...	...	...	...	...
IDAHO							
Boise	34,152	207,709c	677	100	26	33	2.9
Pocatello	25,882	54,705c	319	165	28	25	6.4
ILLINOIS							
Alton	32,176	89,350	524	220	71	5	6.9
Aurora	50,508	113,147	812	223	60	...	4.4
Belleville	32,701	.....	...	...	...	...	...
Berwyn	51,176	56,000c	658	120	37	6	2.4
Bloomington	34,048	402,721c	679	165	70	34	4.9
Champaign	39,397	315,747c	493	321	48	26	8.2
Chicago	3,606,436	9,130,000	45,015	19,241	9,258	3,778	5.3
Chicago Heights	24,369	142,772	195	106	13	22	4.4
Cicero	67,197	73,175	1,080	388	86	66	5.8
Danville	37,892	139,290	675	132	50	7	3.5
Decatur	67,803	159,494	816	340	111	16	5.0
East St. Louis	81,950	.....	...	...	...	...	...
Elgin	42,003	334,744c	625	104	49	26	2.5
Elmhurst	21,204	23,535c	224	26	18	3	1.2
Evanston	73,030	93,565	866	265	56	24	3.6
Freeport	22,425	180,124	324	60	2	24	2.7
Galesburg	31,357	32,860	473	126	45	15	4.0
Granite City	29,139	.....	...	...	...	...	...
Harvey	20,636	13,235	463	118	33	11	5.7
Jacksonville	20,374	169,600	260	103	18	139	5.1
Joliet	52,460	213,231a	1,205	266	50	32	5.1
Kankakee	25,873	.....	...	...	...	...	...
Maywood	27,409	24,995	325	102	32	13	3.7
Moline (e)	37,296	163,144	675	60	35	44	1.6
Oak Park	63,175	83,467	1,202	244	61	12	3.9
Ottawa	22,000	63,725	230	64	22	6	2.9
Pekin	21,912	60,922	287	56	19	4	2.6

a. Estimated. c. Building and contents. e. Not included in totals. f. Subject to change.

City	Population (Last Census)	Total Loss 1952	No. Alarms 1952	No. Bldg. Fires 1952	No. Auto Fires 1952	No. Malicious False Alarms 1952	Bldg. Fires Per 1000 Population
ILLINOIS (Continued)							
Peoria	111,523	460,704	1,644	464	177	113	4.2
Quincy	41,402	138,445	741	243	84	26	5.9
Rockford	92,503	248,576	1,505	493	132	14	5.3
Rock Island	48,594	80,198	859	202	60	16	4.2
Springfield	80,832	225,162	1,455	684	103	40	8.5
Urbana	22,995	40,516a	261	102	25	7	4.4
Waukegan	39,099	103,233	699	524	58	26	13.4
INDIANA							
Anderson	46,809	168,939c	910	357	139	44	7.6
Bloomington	28,191	29,970	591	183	44	10	6.5
East Chicago	54,124	154,770c	1,441	53	61	179	0.9
Elkhart	35,556	53,262	991	320	39	25	9.0
Evansville	109,869	318,001	2,363	878	198	163	8.0
Fort Wayne	132,840	400,734	2,256	953	194	135	7.2
Gary	132,496	370,318	2,977	2,647	179	151	20.0
Hammond	87,423	173,732c	2,363	455	126	118	5.2
Indianapolis	424,683	1,931,754c	5,763	2,477	627	341	5.8
Kokomo	38,600	31,012c	501	232	61	26	6.0
Lafayette	35,508	111,241c	575	203	72	22	5.7
Logansport	20,933	17,570	522	279	58	70	13.3
Marion (e)	30,059	81,827	460	282	71	22	9.4
Michigan City	28,379	158,382	586	219	50	26	7.7
Mishawaka	32,878	36,777c	475	91	81	35	2.8
Muncie	58,364	244,046	973	442	139	56	7.6
New Albany	29,297	652,595	614	303	32	28	10.3
Richmond	39,504	42,730	589	318	57	16	8.1
South Bend	115,698	.....	...	...	...	...	...
Terre Haute	64,047	158,121	1,649	221	130	55	3.5
IOWA							
Ames	23,105	44,736	246	221	5	14	9.6
Burlington	30,639	199,084	572	123	71	2	4.0
Cedar Rapids	72,149	261,830	942	383	92	41	5.3
Clinton	30,151	73,960	468	182	65	8	6.1
Council Bluffs	45,184	553,460	762	215	70	29	4.8
Davenport	73,640	240,122	1,078	343	109	73	4.7
Des Moines	176,954	1,341,185	3,000	706	242	94	4.0
Dubuque	49,528	156,520	964	311	88	12	6.3
Fort Dodge	25,025	29,897	418	121	41	12	4.8
Iowa City	27,018	64,384	280	76	29	1	2.8
Marshalltown	20,000	140,230	277	113	30	28	5.7
Mason City	27,593	95,061	416	78	37	0	2.8
Ottumwa	33,640	187,759c	907	445	47	1	13.2
Sioux City	84,035	216,475	1,151	427	64	50	5.1
Waterloo	64,354	521,089a	1,358	408	90	135	6.4
KANSAS							
Hutchinson	33,524	175,086	637	146	84	5	4.4
Kansas City	129,583	261,298	2,340	660	267	105	5.1
Lawrence	23,292	48,802	351	81	46	...	3.5
Leavenworth	20,543	148,680	489	109	26	1	5.3
Pittsburg	25,134	54,626	703	146	47	0	5.8
Salina	26,141	67,526	669	167	35	8	6.4
Topeka	77,827	267,570c	1,319	346	117	92	4.5
Wichita	166,306	740,677	3,075	691	325	64	4.2

a. Estimated. c. Building and contents only. e. Not included in totals.

City	Population (Last Census)	Total Loss 1952	No. Alarms 1952	No. Bldg. Fires 1952	No. Auto Fires 1952	No. Malicious False Alarms 1952	Bldg. Fires Per 1000 Population
KENTUCKY							
Ashland	31,228	139,038c	447	161	45	7	5.2
Covington	64,282	165,698	601	253	91	51	3.9
Lexington (e)	54,449	1,085,390	1,292	244	97	63	4.5
Louisville	367,359	.....	4,893	2,250	517	280	6.1
Newport	31,015	28,474	348	198	62	20	6.4
Owensboro	33,983	80,000	1,397	302	55	19	8.9
Paducah	32,430	.....	...	...	...	...	...
LOUISIANA							
Alexandria	34,685	135,144c	417	155	44	28	4.5
Baton Rouge	123,957	239,411	1,512	441	130	176	3.6
Lafayette	33,465	171,835	290	130	56	7	3.9
Lake Charles	41,202	.....	...	...	...	...	...
Monroe	38,375	521,891c	1,234	256	89	15	6.7
New Orleans	567,257	1,034,788c	5,409	1,751	221	264	3.1
Shreveport	125,506	534,621	1,604	510	157	94	4.1
MAINE							
Auburn (e)	23,078	.....	489	139	...	1	6.0
Augusta	20,900	30,747c	335	11	69	3	0.5
Bangor	31,473	89,797c	740	339	65	49	10.8
Biddeford	20,700	46,223	309	178	21	5	8.6
Lewiston	41,142	173,158	704	187	38	11	4.6
Portland	76,936	174,973a, c	1,688	162	276	110	2.1
South Portland	21,732	6,837	469	138	14	42	6.4
MARYLAND							
Baltimore	940,205	3,447,958c	13,289	5,677	1,253	1,032	6.0
Cumberland	37,632	.....	452	212	57	29	5.6
Hagerstown	36,232	.....	446	293	47	16	8.1
Montgomery County	163,749	713,957	1,592	636	182	44	3.9
MASSACHUSETTS							
Arlington	43,984	35,910c	1,030	...	62	74	...
Attleboro	23,665	54,851c	673	78	34	11	3.3
Belmont	27,379	47,510c	612	192	44	15	7.0
Beverly	28,855	60,572c	1,049	238	60	12	8.3
Boston	790,863	.....	18,753	4,423	1,069	2,721	5.6
Braintree	23,130	22,750	912	99	40	25	4.3
Brockton	62,856	103,064	1,921	412	112	71	6.6
Brookline	56,952	.....	...	...	...	...	...
Cambridge	120,676	588,219c	2,555	680	171	288	5.6
Chelsea	39,038	168,720	1,334	428	120	86	11.0
Chicopee	48,939	114,294	844	153	47	40	3.1
Everett	45,789	491,029c	1,036	233	58	85	5.1
Fall River	111,759	258,174c	1,456	435	828	45	3.9
Fitchburg	42,671	.....	...	...	...	...	...
Framingham	27,845	.....	...	...	...	...	...
Gloucester	25,048	178,472	814	219	39	29	8.8
Haverhill	47,213	208,420c	1,417	801	57	70	17.0
Holyoke	54,441	.....	...	...	...	...	...
Lawrence	80,427	200,000a	1,771	253	95	93	3.2
Leominster	24,084	54,528	...	...	...	...	...
Lowell	96,523	275,417c	2,083	627	129	92	6.5
Lynn	99,521	348,336	2,937	935	160	193	9.4
Malden	59,779	366,606a	1,391	123	73	37	2.1
Medford	66,109	.....	1,695	300	126	146	4.5
Melrose	26,919	28,131	632	30	6	12	1.1

a. Estimated. c. Building and contents only. e. Not included in totals.

City	Population (Last Census)	Total Loss 1952	No. Alarms 1952	No. Bldg. Fires 1952	No. Auto Fires 1952	No. Malicious False Alarms 1952	Bldg. Fires Per 1000 Population
MASSACHUSETTS (Continued)							
Methuen	24,411	57,686	744	128	29	18	5.3
Milton	22,395	358,250	739	111	46	77	5.0
New Bedford	109,033	213,805	1,523	326	107	52	3.0
Newton	80,996	318,842	1,791	108	57	57	1.3
North Adams	21,475	74,179	401	160	77	8	7.5
Northampton	28,998	147,214	395	182	34	21	6.3
Peabody	22,647	190,121c	836	203	33	17	9.0
Pittsfield	53,055	141,455d	715	231	89	26	4.4
Quincy	83,190	311,263	2,569	397	110	173	4.8
Revere	36,663	131,630	1,400	77	65	156	2.1
Salem	41,842	262,501c	1,143	270	1	...	6.5
Somerville	102,254	494,742	4,024	439	133	229	4.3
Springfield	162,601	963,971	3,781	663	172	315	4.1
Taunton	40,056	123,580c	827	202	40	39	5.1
Waltham	47,198	116,865	1,080	224	77	43	4.8
Watertown	37,339	235,194	1,248	38	5	26	1.0
Wellesley	20,847	35,729b	548	53	39	29	2.5
Westfield	20,961	596,026	679	135	29	4	6.5
West Springfield	20,398	62,209c	1,449	483	31	24	23.8
Weymouth	32,695	123,987	932	81	57	27	2.5
Woburn (e)	20,269	87,956	902	57	37	49	2.9
Worcester	201,885	1,050,911c	4,311	961	...	539	4.8
MICHIGAN							
Ann Arbor	47,279	59,878	530	62	47	10	1.3
Battle Creek	48,469	166,494	961	196	68	86	4.1
Bay City	52,372	666,050	911	229	66	20	4.4
Dearborn	94,529	298,358	1,293	266	98	171	2.8
Detroit	1,838,517	9,294,605	18,571	6,407	1,817	1,898	3.5
East Detroit	21,373	16,531	271	88	27	4	4.1
East Lansing	20,310	9,134	210	8	25	2	0.4
Ferndale	29,670	61,456	425	109	48	33	3.7
Flint	162,800	318,568	1,983	758	201	147	4.7
Grand Rapids	175,647	499,783	1,564	350	82	99	2.0
Hamtramck	43,245	127,255	792	414	34	61	9.6
Highland Park	46,155	120,707c	819	243	85	39	5.3
Jackson	50,904	77,304	956	253	98	41	5.0
Kalamazoo	51,326	137,469	670	176	68	36	3.4
Lansing	91,694	425,393c	2,104	370	150	54	4.0
Lincoln Park	29,265	223,359c	579	127	50	61	4.4
Monroe	21,275	18,710	308	132	29	14	6.2
Muskegon	48,047	182,765	639	164	71	50	3.4
Pontiac	73,112	254,398	1,245	350	102	101	4.8
Port Huron	35,297	96,634c	621	162	57	17	4.6
River Rouge	20,366	54,534	252	78	34	17	3.8
Royal Oak	46,817	243,434	805	256	75	66	5.5
Saginaw	92,352	102,902c	1,424	262	94	57	2.8
Wyandotte	36,666	81,570	534	141	45	122	3.9
MINNESOTA							
Austin	23,035	22,442c	258	130	24	5	5.7
Duluth	104,066	229,664	1,625	244	77	58	2.3
Minneapolis	517 277	1,957,182	6,614	3,755	459	270	7.2
Rochester	29,634	14,258	509	134	44	80	4.5
St. Cloud	22,744	66,546	362	69	25	3	3.0
St. Louis Park	22,495	51,485	502	132	25	3	5.9
St. Paul	309,474	1,324,686a	5,224	804	397	309	2.6
Winona	24,965	11,903	374	155	22	28	6.2

a. Estimated. b. Incomplete. c. Building and contents only. d. Insured loss only. e. Not included in totals.

City	Population (Last Census)	Total Loss 1952	No. Alarms 1952	No. Bldg. Fires 1952	No. Auto Fires 1952	No. Malicious False Alarms 1952	Bldg. Fires Per 1000 Population
MISSISSIPPI							
Biloxi	37,034	48,236	292	65	35	25	1.8
Greenville	29,914	29,497c	511	237	25	17	7.9
Gulfport	22,428	27,740	559	132	54	23	5.9
Hattiesburg	29,432	58,840	494	159	46	4	5.4
Jackson	97,674	216,800	1,167	400	68	68	4.1
Laurel	24,988	442,324	437	134	39	8	5.4
Meridian	41,709	.....	...	...	...	...	...
Natchez	22,678	.....	500	112	119	19	5.0
Vicksburg	27,344	120,270	568	64	32	10	2.3
MISSOURI							
Cape Girardeau	21,539	129,465b	483	151	44	11	7.0
Columbia	31,731	64,308	507	165	57	9	5.2
Hannibal	20,486	29,035	317	106	59	2	5.2
Independence	36,832	88,057	691	149	40	8	4.1
Jefferson City	24,990	71,391a	490	90	31	3	3.6
Joplin	37,188	197,146c	1,308	334	285	32	9.0
Kansas City	439,646	1,888,115	7,306	2,094	703	537	4.8
St. Joseph	75,572	118,892c	1,644	376	121	39	5.0
St. Louis	852,623	1,119,215a, g	10,620	3,387	1,207	1,163	4.0
Sedalia	20,269	69,841	417	158	39	3	7.8
Springfield	66,302	.....	...	...	...	...	...
University City	39,595	58,915	959	225	52	10	5.8
Webster Grove	23,289	.....	...	...	...	...	...
MONTANA							
Billings	31,725	26,264c	398	81	58	35	2.6
Butte	32,904	29,887f	584	270	26	112	8.2
Great Falls	39,006	28,796	507	...	...	30	...
Missoula	22,320	13,589c	275	231	15	10	10.3
NEBRASKA							
Grand Island	22,835	96,572	1,060	129	50	8	5.7
Hastings	20,108	25,551	335	80	26	4	4.0
Lincoln	97,423	200,000a	1,386	393	200	14	4.0
Omaha	247,408	1,163,295	3,059	1,068	375	91	4.3
NEVADA							
Las Vegas	24,418	140,926	738	263	981	40	10.8
Reno	32,225	198,600c	1,073	359	53	20	11.1
NEW HAMPSHIRE							
Concord	27,984	51,524	669	386	89	17	13.8
Manchester	82,581	589,000f	1,275	237	95	40	2.9
Nashua	34,666	45,007c	502	206	74	12	6.0
NEW JERSEY							
Atlantic City (e)	61,642	3,046,439	781	367	89	81	6.0
Bayonne	76,657	.....	992	345	66	92	4.5
Belleville	32,059	71,785c	609	128	74	44	4.0
Bloomfield	49,313	82,042	803	169	51	55	3.4
Camden	125,546	291,340c	2,019	416	154	154	3.3
Clifton	64,567	255,040	896	103	57	15	1.6
East Orange	78,057	85,958b	845	255	81	67	3.3
Elizabeth	112,675	.....	...	...	...	...	...
Englewood	23,092	.....	...	...	...	...	...
Fair Lawn	23,865	.....	...	...	...	...	...
Garfield	27,605	.....	...	...	...	...	...
Hackensack	29,207	26,795c	603	105	39	24	3.6
Hillside	21,000	107,160	421	152	38	1	7.2

a. Estimated. b. Incomplete. c. Building and contents only. e. Not included in totals. f. Subject to change. g. April 1, 1952-February 28, 1953.

City	Population (Last Census)	Total Loss 1952	No. Alarms 1952	No. Bldg. Fires 1952	No. Auto Fires 1952	No. Malicious False Alarms 1952	Bldg. Fires Per 1000 Population
NEW JERSEY (Continued)							
Hoboken	50,510	135,072c	978	341	68	322	6.8
Irvington	59,142	64,040	465	207	49	27	3.5
Jersey City	300,447	561,685a, c	3,515	1,306	212	305	4.4
Kearny	39,828	88,000	464	88	42	34	2.2
Linden	30,434	59,247c	736	286	155	32	9.4
Long Branch	23,094	.....	...	...	...	...	...
Maplewood	25,000	12,650	249	89	37	21	3.6
Montclair	43,775	60,034	590	172	69	40	3.9
Newark	437,857	1,820,518	6,053	2,350	870	692	5.4
New Brunswick	38,768	669,105c	599	186	47	44	4.8
North Bergen Twp.	39,714	224,975c	940	95	86	20	2.4
Nutley	26,746	38,105	502	93	25	35	3.5
Orange	38,413	60,038	461	211	49	28	5.5
Passaic	57,851	205,910	835	300	72	52	5.2
Paterson	139,423	283,000a, c	1,784	909	168	104	6.5
Perth Amboy	41,291	.....	...	...	...	...	...
Plainfield	42,212	108,967c	637	183	61	25	4.3
Rahway	21,287	.....	446	144	24	11	6.8
Teaneck Twp.	34,000	44,811	739	93	35	22	2.7
Trenton	127,867	432,523	1,510	655	169	143	5.1
Union City	55,322	474,050c	1,030	266	59	35	4.8
Union Twp.	39,000	95,901	651	160	52	7	4.1
West New York	37,754	233,405	629	100	46	16	2.7
Westfield	21,335	.....	440	98	31	5	4.6
West Orange	28,624	23,010	380	47	61	27	1.6
NEW MEXICO							
Albuquerque	97,000	.....	...	...	...	...	...
Roswell	25,572	60,549	295	151	57	2	5.9
Santa Fe	29,750	21,181	166	83	31	6	2.8
NEW YORK							
Albany	134,382	311,522c	3,754	691	249	326	5.1
Amsterdam	32,269	68,615c	301	108	19	14	3.4
Auburn	36,667	83,316c	447	129	39	29	3.5
Binghamton	81,132	300,556c	866	192	...	21	2.4
Buffalo	477,393	1,884,185a	6,508	1,076	294	208	2.3
Cohoes	21,235	.....	...	...	...	...	...
Elmira	49,690	58,754c	568	223	70	24	4.5
Endicott	20,168	94,263c	183	56	21	9	2.8
Freeport	24,589	.....	...	...	...	...	...
Gloversville	23,576	160,757c	287	61	25	11	2.6
Hempstead	29,021	.....	...	...	...	...	...
Irondiquoit Twp.	34,045	.....	...	...	...	...	...
Ithaca	29,395	48,113	226	101	30	8	3.4
Jamestown	43,250	586,298c	659	161	40	17	3.7
Kenmore	20,332	42,022	137	31	13	15	1.5
Kingston	28,860	28,249c	502	180	44	14	6.2
Lackawana	27,646	266,102	371	54	10	52	2.0
Lockport	25,136	98,470	507	160	33	13	6.4
Middletown	22,565	14,948	307	98	35	6	4.4
Mount Vernon	71,837	203,142	1,137	254	49	76	3.5
Newburgh	31,924	32,383c	312	144	48	29	4.5
New Rochelle	59,626	151,891	780	296	62	26	5.0
New York	7,835,099	26,948,062c	74,443	24,198	5,472	13,981	3.1
Niagara Falls	90,875	194,015	1,313	306	72	116	3.4
North Tonawanda	24,730	420,630c	413	197	14	12	8.0
Olean	22,842	107,576	354	71	22	8	3.1
Oswego	22,611	91,761	319	102	21	5	4.5

a. Estimated. c. Building and contents only.

City	Population (Last Census)	Total Loss 1952	No. Alarms 1952	No. Bldg. Fires 1952	No. Auto Fires 1952	No. Malicious False Alarms 1952	Bldg. Fires Per 1000 Population
NEW YORK (Continued)							
Port Chester	23,969	317,695	289	102	34	5	4.3
Poughkeepsie	40,975	146,160	443	194	47	37	4.7
Rochester	331,252	679,083c	4,024	936	227	151	2.8
Rockville Centre	22,274	.....	...	...	...	...	...
Rome	41,379	109,536c	542	119	32	36	2.9
Schenectady	92,070	233,897	1,081	268	106	82	2.9
Syracuse	220,067	1,021,390	1,824	691	236	175	3.1
Troy	71,659	177,708c	1,315	734	211	24	10.2
Utica	101,479	445,780	1,017	296	102	44	2.9
Valley Stream	26,833	.....	...	...	...	...	...
Watertown	34,280	44,580c	494	140	45	51	4.1
White Plains	43,501	83,303c	586	183	55	39	4.2
Yonkers	152,533	467,787a, c	2,419	534	142	93	3.5
NORTH CAROLINA							
Asheville	52,208	100,636c	863	220	69	70	4.2
Burlington	24,495	118,547	478	114	47	18	4.7
Charlotte	133,219	648,068	2,606	966	204	342	7.2
Durham	70,307	617,372c	896	474	105	52	6.7
Fayetteville	34,605	112,452	977	307	105	64	8.9
Gastonia	23,003	65,250c	331	189	32	10	8.2
Goldsboro	21,399	23,098	444	252	48	11	11.8
Greensboro	73,703	181,057c	1,098	359	125	74	4.9
High Point	39,930	183,094c	730	314	57	57	7.9
Raleigh	65,123	342,465	941	84	71	60	1.3
Rocky Mount	27,644	45,161c	395	239	47	13	8.7
Wilmington	44,925	.....	...	...	...	...	...
Wilson	22,964	.....	...	...	...	...	...
Winston-Salem	86,816	337,540b	1,069	165	88	67	1.9
NORTH DAKOTA							
Fargo	37,981	76,883a	308	...	...	...	...
Grand Forks	26,617	41,000	266	142	44	10	5.3
Minot	21,924	125,511	282	211	21	0	9.6
OHIO							
Akron	273,189	611,683	2,598	648	301	312	2.4
Alliance	26,112	87,325	140	54	30	...	2.1
Ashtabula	23,093	125,270	401	101	30	14	4.4
Barberton	27,893	186,190	349	103	40	33	3.7
Canton	116,312	265,370c	1,148	251	120	123	2.2
Chillicothe	20,121	56,216	277	64	44	5	3.2
Cincinnati	500,510	1,299,300	5,681	2,030	625	369	4.1
Cleveland	905,636	3,197,536a	10,553	2,888	878	850	3.2
Cleveland Heights	58,782	43,935	1,100	229	45	12	3.9
Columbus	374,770	445,552	16,357	2,711	693	176	7.2
Cuyahoga Falls	29,076	31,264	414	135	38	40	4.7
Dayton	243,108	269,717	3,322	706	309	265	2.9
East Cleveland	39,873	18,560	554	110	31	9	2.8
East Liverpool	24,072	225,731c	660	342	59	7	14.2
Elyria	30,197	58,249	277	115	35	4	3.8
Euclid	41,447	72,980	589	122	46	16	2.9
Findlay	23,806	46,240c	302	110	38	4	4.6
Garfield Heights	21,606	.....	...	...	...	...	...
Hamilton	57,717	209,720	1,238	298	92	36	5.2
Lakewood	67,878	53,477	375	99	34	39	1.5
Lancaster	24,140	49,374	715	105	57	26	4.4
Lima	49,880	81,815	618	263	92	22	5.3
Lorain	50,819	62,375	625	124	68	25	2.4

a. Estimated. b. Incomplete. c. Building and contents only.

City	Population (Last Census)	Total Loss 1952	No. Alarms 1952	No. Bldg. Fires 1952	No. Auto Fires 1952	No. Malicious False Alarms 1952	Bldg. Fires Per 1000 Population
OHIO (Continued)							
Mansfield	43,363	243,015	608	273	108	19	6.3
Marion	33,786	53,941	367	151	70	2	4.5
Massillon	29,524	78,952	296	124	38	16	4.2
Middletown	33,634	59,312	540	177	60	44	5.3
Newark	34,178	79,809	770	177	87	33	5.2
Norwood	34,626	23,817	268	127	32	16	3.7
Parma	28,852	47,163	725	48	30	5	1.7
Portsmouth	36,663	59,529a	422	146	77	17	4.0
Sandusky	29,060	52,287	859	213	39	7	7.3
Shaker Heights	27,980	166,101	568	224	41	58	8.0
Springfield	78,029	351,549	1,205	513	146	85	6.6
Steubenville	35,695	25,925	443	126	67	58	3.5
Toledo	301,358	1,333,600	3,408	1,094	401	254	3.6
Warren	49,674	240,351	545	128	66	20	2.6
Youngstown	167,643	453,425	1,667	434	179	124	2.6
Zanesville	40,424	63,576	499	161	62	100	4.0
OKLAHOMA							
Enid	35,976	60,315c	625	199	84	24	5.5
Lawton	34,527	136,049	791	299	64	4	8.7
Muskogee	37,255	104,875c	947	197	72	21	5.3
Norman	26 972	15,395	395	62	33	3	2.3
Oklahoma City	242,450	516,941	4,630	1,313	353	72	5.4
Ponca City	20,185	29,239	486	88	20	22	4.4
Shawnee	24,457	98,637c	412	61	38	9	2.5
Stillwater	20,155	15,136	374	95	27	1	4.7
Tulsa	180,586	776,348	2,844	737	171	177	4.1
OREGON							
Eugene	35,672	87,583	567	362	57	16	10.2
Portland	371,011	1,200,004c	4,991	2,899	387	253	7.8
Salem	43,064	81,774	531	340	30	10	7.9
PENNSYLVANIA							
Aliquippa	26,067	8,620c	163	79	26	15	3.0
Allentown	106,233	173,962	361	184	60	24	1.7
Altoona	76,844	190,435	803	179	70	138	2.3
Bethlehem	66,027	58,482b	332	306	...	11	4.6
Butler	23,511	69,510	357	77	61	2	3.3
Cheltenham Twp.	23,000	27,995	239	63	17	1	2.7
Chester	65,824	212,970	628	336	48	25	5.1
Dunmore	20,302	3,500c	95	17	11	15	0.8
Easton	34,410	42,923c	196	108	32	8	3.1
Erie	130,125	112,818	2,179	919	116	109	7.1
Harrisburg	89,091	250,000f	532	281	78	40	3.2
Haverford Twp.	40,000	4,500a	51	18	2	3	0.5
Hazleton	35,486	.....	...	...	...	...	...
Johnstown	62,723	141,179	832	258	48	54	4.1
Kingston	21,061	5,000c	154	39	19	15	1.9
Lancaster	63,601	28,290c	313	182	59	18	2.9
Lebanon	28,134	.....	...	...	...	...	...
Lower Marion Twp.	49,000	209,806	811	148	50	4	3.0
McKeesport	51,223	78,760	632	286	43	49	5.6
Mount Lebanon Twp.	26,604	31,745	282	85	10	...	3.2
Nanticoke	20,140	.....	...	...	...	...	...
New Castle	48,563	140,478	634	261	83	30	5.4
New Kensington	25,226	.....	...	...	...	...	...
Norristown	38,143	.....	...	...	...	...	...
Philadelphia	2,064,794	11,927,615	23,834	6,685	1,896	3,475	3.2

a. Estimated. b. Incomplete. c. Building and contents only. f. Subject to change.

City	Population (Last Census)	Total Loss 1952	No. Alarms 1952	No. Bldg. Fires 1952	No. Auto Fires 1952	No. Malicious False Alarms 1952	Bldg. Fires Per 1000 Population
PENNSYLVANIA (Continued)							
Pittsburgh	673,763	.....	...	...	...	...	...
Pottstown	22,616	126,526c	124	122	...	2	5.4
Pottsville	23,642	34,211	107	46	12	3	1.9
Reading	109,062	.....	...	...	...	...	...
Scranton	124,305	822,000a	1,188	308	132	154	2.5
Sharon	26,305	43,876c	257	62	32	3	2.4
Uniontown	20,423	.....	...	...	...	...	...
Upper Darby Twp.	186,000	63,107c	479	133	43	...	0.7
Washington	25,898	21,867	187	124	39	13	4.8
Wilkes-Barre	76,638	166,922	573	208	70	23	2.7
Wilkinsburg	31,281	15,135c	394	197	29	25	6.3
Williamsport	44,946	305,438c	589	...	26	7	...
York	59,704	77,471c	...	266	...	...	4.5
RHODE ISLAND							
Central Falls	23,610	30,103c	300	83	24	18	3.5
Cranston	55,130	90,138	1,126	184	68	21	3.3
East Providence	35,791	100,076	831	144	38	43	4.0
Newport	32,090	68,887	416	290	25	21	9.1
Pawtucket	81,180	293,001	1,554	272	108	120	3.4
Providence	274,700	90,138c	1,127	184	68	21	6.7
Warwick Twp.	43,027	300,497	1,748	175	76	47	4.1
Woonsocket	50,186	.....	...	...	...	...	...
SOUTH CAROLINA							
Charleston	68,243	228,018c	1,023	483	118	123	7.1
Columbia (e)	85,949	411,972c	1,191	420	106	56	4.9
Greenville	57,932	683,653	990	412	139	73	7.1
Spartanburg	36,674	208,599	716	199	80	78	5.4
SOUTH DAKOTA							
Rapid City	25,179	64,794	346	77	42	0	3.1
Sioux Falls	52,161	150,873	487	164	41	9	3.1
TENNESSEE							
Chattanooga	130,333	509,524a, c	2,102	694	165	101	5.3
Jackson	30,098	185,332	457	...	33	7	...
Johnson City	27,778	22,335	578	223	48	9	8.1
Knoxville	124,183	197,102c	2,388	...	171	154	...
Memphis	394,012	1,262,157	6,662	...	2,005	2,900	...
Nashville	173,359	1,024,734c	2,969	1,038	251	244	6.0
TEXAS							
Abilene	47,102	230,000	649	251	84	30	5.3
Amarillo	73,737	1,901,018c	1,373	208	167	107	2.8
Austin	131,964	347,571c	1,992	398	167	45	3.0
Baytown	22,927	16,828c	273	83	30	10	3.6
Beaumont	93,715	382,299a	1,460	583	129	55	6.2
Brownsville	36,176	68,238	274	101	38	23	2.8
Brownwood	20,140	37,833	1,952	39	23	46	1.9
Corpus Christi	108,053	610,386c	1,093	376	115	95	3.5
Dallas	432,927	2,944,316c	9,367	1,392	712	304	3.2
Denton	21,345	53,691c	377	99	32	1	4.7
El Paso	130,000	230,000a, c	1,493	535	130	82	4.1
Fort Worth	277,047	1,623,931	5,415	1,575	517	324	5.7
Galveston	65,898	90,300c	1,059	356	69	178	5.4
Harlingen	23,202	16,450c	249	46	35	12	2.0
Houston	594,321	2,838,437c	8,289	2,656	651	854	4.5
Laredo	51,694	39,764c	339	122	31	9	2.4

a. Estimated. c. Building and contents only. e. Not included in totals.

City	Population (Last Census)	Total Loss 1952	No. Alarms 1952	No. Bldg. Fires 1952	No. Auto Fires 1952	No. Malicious False Alarms 1952	Bldg. Fires Per 1000 Population
TEXAS (Continued)							
Longview	24,445	115,929	590	157	53	0	6.4
Lubbock	71,390	207,900	821	373	85	20	5.2
Marshall	22,255	152,906a, c	521	82	34	10	3.7
McAllen	20,005	25,162c	169	65	22	...	3.3
Midland	21,756	.....	...	...	...	...	...
Odessa	29,432	202,770c	439	214	76	22	7.3
Orange	21,100	36,493c	585	118	52	21	5.6
Paris	21,636	49,049c	594	167	28	4	7.7
Pasadena	22,444	48,868c	225	38	21	0	1.7
Port Arthur	57,377	132,349c	587	140	52	81	2.4
San Angelo	51,889	185,881c	570	362	80	37	7.0
San Antonio	406,811	1,061,708	4,354	1,432	500	233	3.5
Sherman	20,013	.....	...	...	...	...	...
Temple	24,970	208,468	388	57	35	19	2.3
Texarkana	24,657	.....	...	...	...	...	...
Tyler	38,864	178,769c	508	193	70	24	5.0
University Park	23,823	51,704c	194	134	25	0	5.6
Waco	84,300	267,267	972	830	109	33	9.8
Wichita Falls	67,709	920,380	1,577	793	61	59	11.7
UTAH							
Ogden	56,910	301,616	1,734	165	54	51	2.9
Provo City	28,901	154,344	243	83	23	11	2.9
Salt Lake City	181,718	391,688	2,213	734	139	110	4.0
VERMONT							
Burlington	33,039	.....	619	314	41	31	9.5
VIRGINIA							
Alexandria	61,604	117,705c	859	362	103	15	5.9
Arlington County	134,990	.....	...	...	...	...	...
Charlottesville	25,909	26,950c	286	80	49	11	3.1
Danville	34,537	123,591	518	212	76	29	6.2
Hampton	60,994	7,045	211	82	13	9	1.3
Lynchburg	47,639	229,087	751	683	...	59	14.3
Newport News	41,571	348,789a	766	391	49	56	9.4
Norfolk	188,601	1,341,046	3,698	1,042	200	432	5.5
Petersburg	34,948	45,714	721	351	72	46	10.1
Portsmouth	71,294	.....	1,321	340	83	93	4.8
Richmond	229,906	361,910	3,738	2,346	425	321	10.2
Roanoke	91,089	302,663	1,262	589	...	121	6.5
Warwick	39,875	95,216	527	248	55	6	6.2
WASHINGTON							
Bellingham	33,934	98,445c	690	444	52	10	13.1
Bremerton	27,746	179,347	556	301	58	24	10.9
Everett	33,807	87,935c	715	127	40	42	3.8
Longview	20,556	171,099c	247	153	15	36	7.5
Seattle	462,985	549,506	4,422	1,561	444	202	3.4
Spokane	160,484	.....	2,306	984	169	149	6.1
Tacoma	142,975	709,968	2,554	1,210	184	106	8.5
Vancouver	27,977	236,545c	987	78	42	38	2.8
Walla Walla	24,071	85,266	476	146	32	26	6.1
Yakima	38,375	45,308	674	349	49	29	9.1
WEST VIRGINIA							
Bluefield	21,341	133,625	254	231	15	8	10.8
Charleston	72,818	901,151	994	572	178	166	7.9
Clarksburg	31,817	96,965c	256	80	...	...	2.5
Fairmont	29,273	.....	...	...	...	...	...

a. Estimated. c. Building and contents only.

City	Population (Last Census)	Total Loss 1952	No. Alarms 1952	No. Bldg. Fires 1952	No. Auto Fires 1952	No. Malicious False Alarms 1952	Bldg. Fires Per 1000 Population
WEST VIRGINIA (Continued)							
Huntington	86,160	782,908c	1,470	430	124	157	5.0
Morgantown	25,443	183,650	464	190	27	9	7.5
Parkersburg	40,492	88,131c	345	80	49	23	2.0
Weirton	24,143	12,287	138	38	16	3	1.6
Wheeling	58,447	35,258	1,006	236	115	27	4.0
WISCONSIN							
Appleton	33,892	158,502	666	276	27	36	8.2
Beloit	29,541	101,353	643	231	117	21	7.8
Eau Claire	35,862	51,502	718	192	41	29	5.4
Fond du Lac	29,826	51,500	366	152	24	39	5.1
Green Bay	52,443	108,992	960	282	61	56	5.4
Janesville	24,829	47,632	611	231	34	14	9.3
Kenosha	54,360	149,869	1,006	280	63	23	5.2
La Crosse	47,396	242,148	720	390	70	35	8.2
Madison (e)	95,594	89,675d	1,369	718	101	35	7.5
Manitowoc	27,444	235,502a	430	114	33	19	4.2
Milwaukee	632,651	2,289,393	9,229	1,542	551	361	2.4
Oshkosh	40,934	.....	483	232	41	20	5.7
Racine	70,749	84,510	1,615	235	61	55	3.3
Sheboygan	42,485	88,971	413	284	34	...	6.7
Superior	35,091	182,908	732	304	56	19	8.7
Waukesha	21,186	145,984	348	155	16	0	7.4
Wausau	30,386	43,174c	566	403	30	11	13.3
Wauwatosa	33,300	33,019	451	257	21	10	7.7
West Allis	42,945	130,760	721	154	29	12	3.6
WYOMING							
Casper	33,557	164,510	317	133	30	26	4.0
Cheyenne	31,807	45,289	428	117	24	23	3.7

1952 FIRE LOSSES, CANADIAN CITIES

ALBERTA							
Calgary	135,000	170,827	1,280	737	73	173	5.5
Edmonton	158,912	240,064c	1,512	350	59	243	2.2
Lethbridge	23,000	18,827	232	40	20	12	1.7
BRITISH COLUMBIA							
Burnaby	60,000	139,946	540	75	39	9	1.2
New Westminster	30,000	935,753	381	70	42	168	2.3
Saanich	24,000	23,765	514	136	18	...	5.7
Vancouver	385,500	.....	...	...	...	...	...
Victoria	50,774	130,007	842	136	17	54	5.7
MANITOBA							
Brandon	21,214	9,000	241	63	...	13	3.0
St. Boniface	26,214	35,191	421	154	21	28	5.9
Winnipeg	229,045	.....	...	...	...	...	...
NEW BRUNSWICK							
Moncton	30,000	132,638	460	175	19	22	5.8
Saint John	63,000	677,595	1,273	119	35	64	1.9
NOVA SCOTIA							
Glace Bay	28,000	40,767c	88	80	2	...	2.9
Halifax	122,656	188,148	1,357	862	47	145	7.0
Sydney	28,305	65,132	540	...	...	192	...

a. Estimated. c. Building and contents only. d. Insured loss only.

City	Population (Last Census)	Total Loss 1952	No. Alarms 1952	No. Bldg. Fires 1952	No. Auto Fires 1952	No. Malicious False Alarms 1952	Bldg. Fires Per 1000 Population
ONTARIO							
Brantford	36,602	63,021	562	92	63	37	2.5
Chatham	22,000	74,300c	467	175	15	12	8.0
East York Twp.	67,000	73,890c	379	90	32	10	1.3
Etobicoke	46,000	94,105	442	229	47	11	5.0
Fort William	30,585	39,133	596	585	11	14	19.0
Galt	23,085	62,641c	264	120	26	10	5.2
Guelph	25,962	380,282	404	234	28	2	9.0
Hamilton	196,246	1,275,914	2,456	863	241	201	4.4
Kingston	36,000	182,021	619	296	46	54	8.2
Kitchener	43,084	380,601	266	147	26	4	3.4
London	94,027	308,233	903	212	...	30	2.3
Niagara Falls	20,589	127,865	230	71	38	22	3.5
North York Twp.	62,646	123,038b	756	286	51	31	4.6
Oshawa	40,727	101,769	465	254	49	23	6.2
Ottawa	220,026	495,391	2,428	1,114	180	126	5.1
Peterboro	35,065	505,525c	589	57	36	28	1.6
Port Arthur	32,000	240,104	615	104	23	30	3.3
St. Catharines	37,988	113,597c	500	165	43	10	4.4
Sarnia	35,000	120,132a, c	359	153	30	24	4.4
Sault Ste. Marie	33,000	259,643	359	184	28	30	5.6
Scarboro Twp.	60,000	94,455	770	133	17	94	2.2
Sudbury	30,222	260,685c	535	105	30	57	2.1
Timmins	26,385	67,566	577	54	27	10	2.0
Toronto	666,467	3,628,095a	6,443	2,699	606	630	4.0
Windsor	121,011	320,000a	1,280	530	80	137	4.4
York Twp.	98,000	148,783c	684	98	49	26	1.0
QUEBEC							
Chicoutimi	21,337	.....	...	...	...	...	...
Hull	43,871	134,393c	999	916	...	83	2.1
Jonquiere	25,765	.....	492	57	11	49	2.2
Lachine	29,625	115,062	125	11	7	62	0.4
Montreal	1,181,955	5,967,947	11,335	2,187	524	3,079	1.9
Outremont	32,000	136,755	130	...	13	23	...
Quebec	205,115	1,036,458	2,708	572	104	613	2.8
Shawinigan Falls	38,000	20,095	302	34	6	30	0.9
Sherbrooke	52,000	70,096	878	43	33	90	0.8
Three Rivers	53,000	62,670	568	379	26	71	7.1
Verdun	79,050	172,344c	693	440	29	94	5.6
Westmount	27,203	78,379	308	79	20	30	2.9
SASKATCHEWAN							
Moose Jaw	25,000	17,032	430	288	15	79	11.5
Regina	69,995	111,785	472	294	7	103	4.2
Saskatoon	53,000	157,669	667	379	24	53	7.2

a. Estimated. b. Incomplete. c. Building and contents only.

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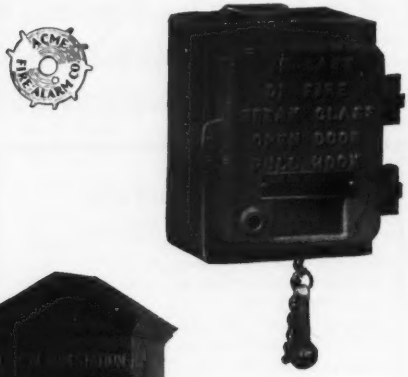

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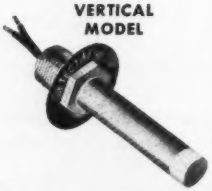

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These extinguishers are for electrical fire hazards: (L to R) Pyrene Vaporizing Liquid Pump and Pressure Types; C-O-Two Carbon Dioxide Type; C-O-Two Dry Chemical Type.

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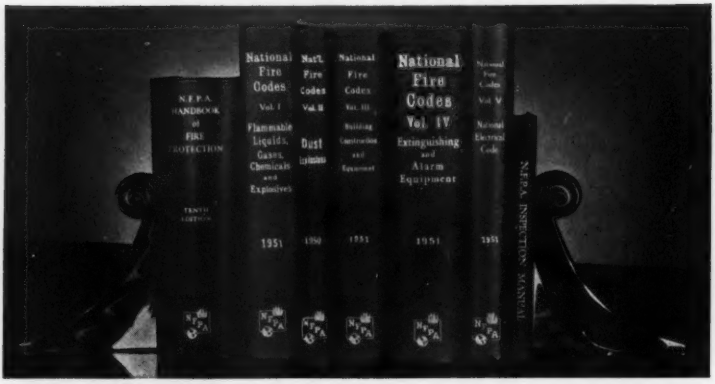

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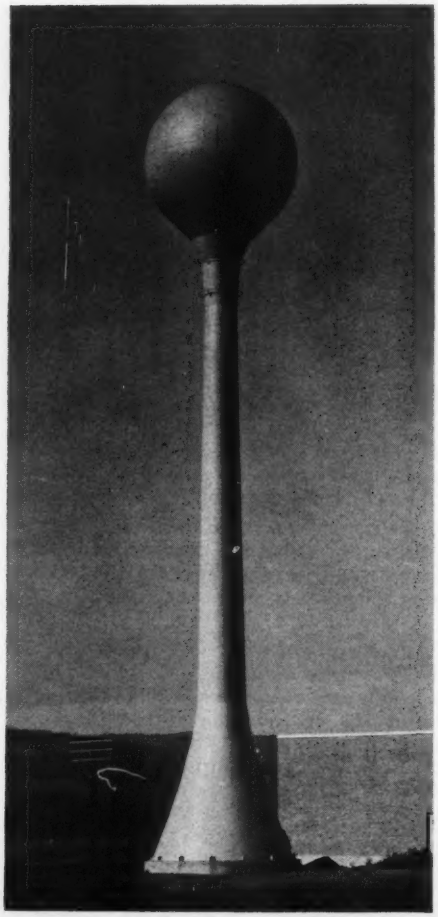

This 50,000-gal. Watersphere, 100-ft. to bottom, has been installed at the new warehouse of the "Junket" Brand Foods Division of Chr. Hansen's Laboratory, Inc., near Little Falls, N. Y. It provides gravity water pressure for the automatic sprinkler system which protects the entire building.

The new warehouse is 124 ft. by 408 ft. and has 750,000 cu. ft. of storage capacity, 81,000 ft. of which is refrigerated. It is used for the storage of finished goods awaiting shipment to the grocery trade and for raw materials. Shuttle trucks bring "Junket" Brand foods to the warehouse and return to the factory with raw materials. Shipments from the warehouse are made via truck or rail from the Company's own siding.

While blanket insurance rates have not yet been established, it is estimated that the tank and sprinkler system will pay for themselves in about 11 years.

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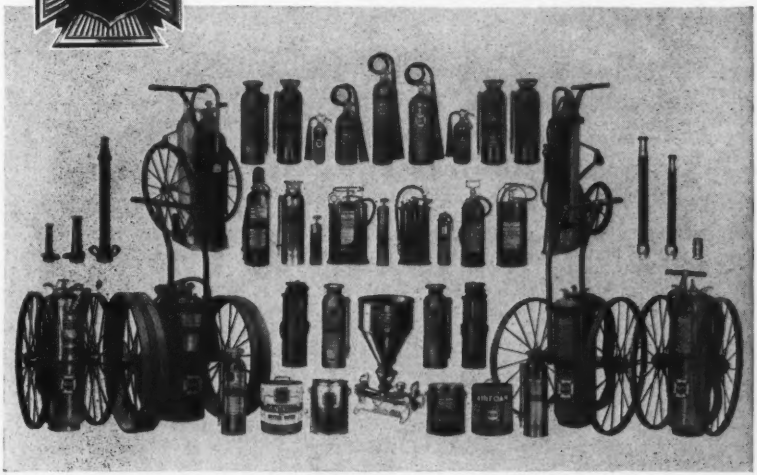

Only a few mentions are possible in this limited space, but the following will serve to indicate that Alfco makes a dependable fire-fighting unit for extinguishing every kind of fire.

Fire Extinguishers: Foamite, Soda-Acid, Anti-Freeze, all Water Types, Carbon Dioxide, Dry Chemical and Vaporizing Liquid.

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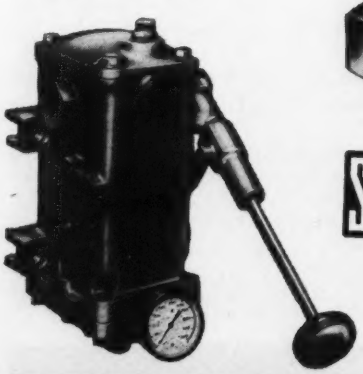

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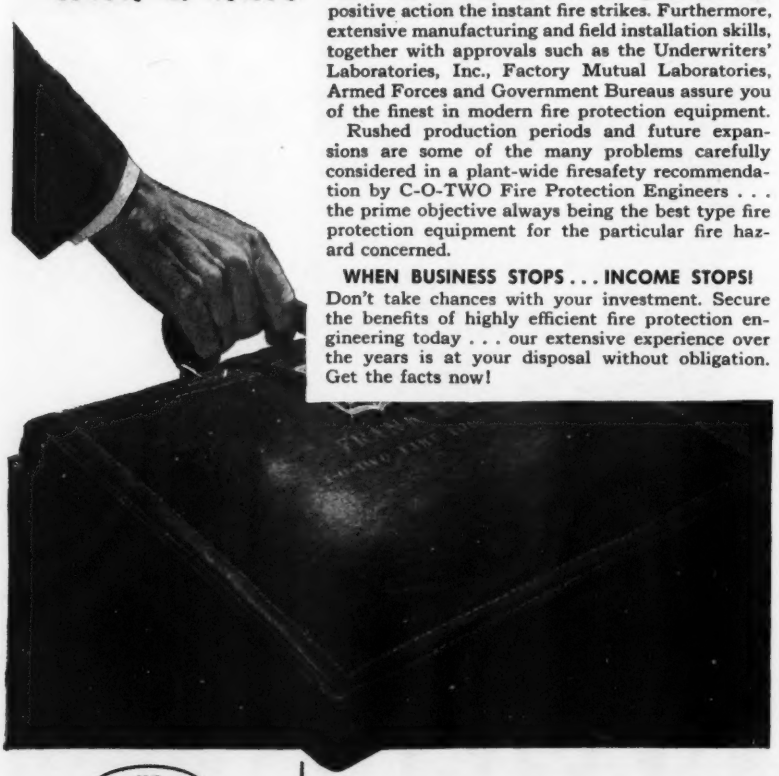

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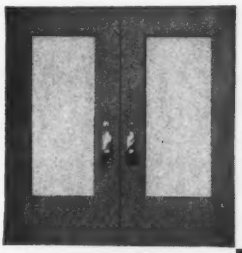
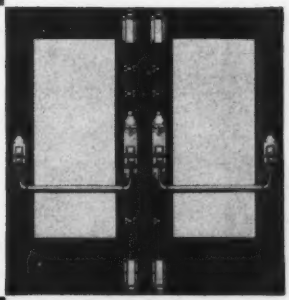


ready for increased traffic

Call in your



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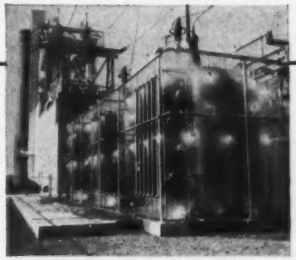

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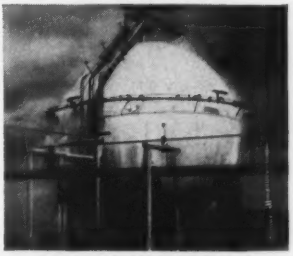

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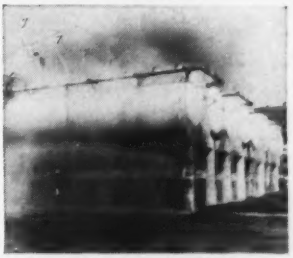

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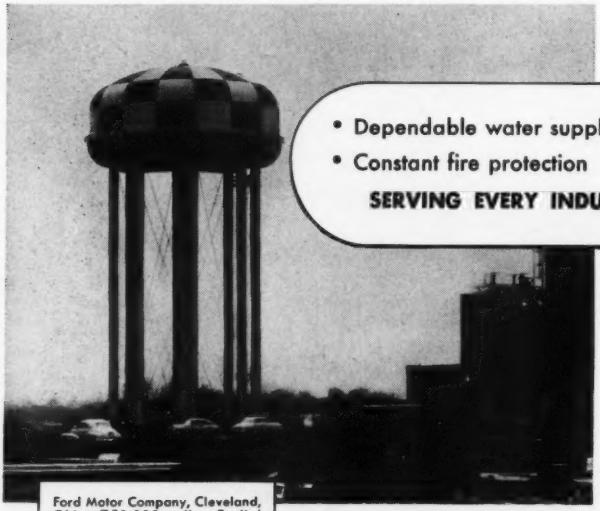

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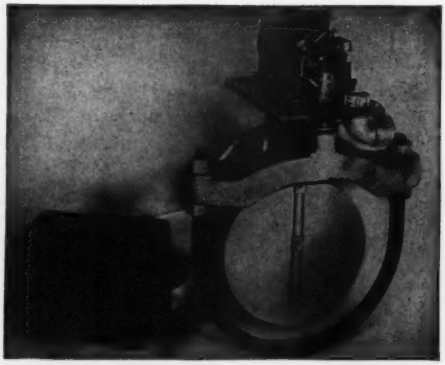

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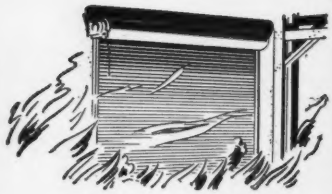

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Safety Features Give Building Occupants EXTRA Protection

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Mills: WOODBERRY, BALTIMORE, MD.

"Fire-Chief" Finished
U. S. Patent No. 2,209,612 and other patents
HOOPERWOOD COTTON DUCK

GLOBE SPRINKLERS

FIREMEN EVERY 10 FEET

A PHONE CALL BRINGS FULL DETAILS!

The big reduction in *FIRE* insurance premiums is a major reason for installing GLOBE Automatic Sprinkler systems. GLOBE Automatic Sprinklers *discover and stop FIRE.* Ask our nearest office how much they can save you.

GLOBE AUTOMATIC SPRINKLER CO.

NEW YORK . . . CHICAGO . . . PHILADELPHIA

Offices in nearly all principal cities

THEY PAY FOR THEMSELVES

43% of all businesses shut down by fire are now as extinct as dinosaurs. Records burned, orders destroyed, customers lost. Better protect your business with a KIDDE fully AUTOMATIC CO_2 Fire Extinguishing System.

Kidde

*according to a Survey by the Safe Manufacturers' National Association

Walter Kidde & Company, Inc.
451 Main Street, Belleville 9, N. J.
Walter Kidde & Company of Canada, Ltd., Montreal, P. Q.

Automatic Rolling Steel
FIRE DOORS *and* WINDOW SHUTTERS PREVENT SPREAD *of* FIRE!

You need good automatic fire doors in fire walls, corridors, and vertical shafts . . . in some cases automatic rolling steel window shutters are necessary to protect your building and its contents from fires which may originate in nearby buildings. Many, many cases are on file which confirm that timely action of automatic rolling steel fire doors and window shutters have confined a fire to its point of origin and permitted its being extinguished with comparatively small damage. Make a survey of your building now, and don't delay action. You will find a Mahon Automatic Rolling Steel Fire Door or Window Shutter to meet each of your requirements—all bear the Underwriters' Label. These automatic fire doors may be operated manually or mechanically in every day use. If a fire should break out while they are in the open position, the automatic mechanism will close the door, cutting off drafts and preventing the spread of the fire. See Sweet's Files for complete information, or ask for Catalog G-52.

THE R. C. MAHON COMPANY
Detroit 34, Michigan • Chicago 6, Illinois

Manufacturers of Automatic Rolling Steel Fire Doors and Window Shutters. Also Many Types of Standard General Service Rolling Steel Doors and Grilles, Insulated Metal Walls, and Steel Deck for Roofs, Floors and Partitions.

Above: Typical Mahon Automatic Rolling Steel Fire Shutter. At Right: Mahon Automatic Rolling Steel Fire Door Installed in a Dividing Fire Wall in a Bus Garage.

MAHON ROLLING STEEL FIRE DOORS and WINDOW SHUTTERS

Fast Acting Rockwood T-Head System smothers flames Quick!

. . . fire stops dead in its tracks under dense WaterFOG

You can use Rockwood T-Heads in fixed piping systems. Water, broken up into the Rockwood WaterFOG pattern by the pendent T-Heads, quickly extinguishes fires in flammable liquids and other combustibles.

Here's how it works. Each T-Head has a wide angle discharge which envelops rising gases and flames. Fewer T-Heads are needed to localize fire. Overlapping coverage of the T-Heads acts as a barrier between fire and ceiling — no water is discharged directly onto ceiling. Even wood ceilings are cooled and protected from the most intense heat.

ROCKWOOD

ROCKWOOD SPRINKLER COMPANY

Engineers Water . . . to Cut Fire Losses

Rockwood T-Heads are recommended for automatic or open deluge use and can be used as either sealed or open heads. Plan now to cut your fire losses. Specify Rockwood T-Heads!

SEND FOR THIS HELPFUL BOOKLET

ROCKWOOD SPRINKLER COMPANY
56 HARLOW STREET
WORCESTER 5, MASS.

Please send me the 12-page, illustrated booklet, "15 Types of Fire Protection," giving actual case histories of different types of fire control.

Name .....
Title .....
Company .....
Street .....
City .....
Zone ..... State .....

ROLAGRIP

Couplings for plain end pipe

GRUVAGRIP

Couplings for grooved pipe

Use Rolagrip couplings on sprinkler systems and you'll enjoy all the time-saving advantages of working with plain end pipe — no threading, grooving, flanging or welding! Or, if the job calls for grooved pipe, Gustin-Bacon offers easy-to-use Gruvagrip couplings.

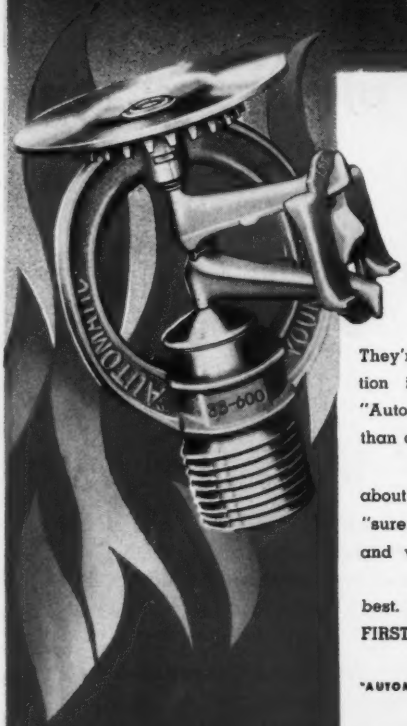
Both are approved by Factory Mutual Laboratories and listed by Underwriters' Laboratories for use on sprinkler systems. Experience proves real savings where you encounter close work, cut-ins, vibration, water hammers. Both are easy to apply, easy to dismantle, and automatically allow for shock, end pull, vibration, expansion and contraction. Available in sizes ¾″ to 12″ at your favorite supply store.

GUSTIN-BACON MANUFACTURING CO.
210 W. 10th St., Kansas City, Mo.

Sure Fire Killer!

"Automatic" SPRAY Sprinkler

UL LISTED AND FM APPROVED



YOU should specify "Automatic" SPRAY Sprinklers for your new building now in the planning stage or an old one, soon to be renovated. For here is a completely new fire fighting device that provides protection far superior to conventional approved sprinklers. They're recognized as preferred for installation in all types of occupancies. Yet, "Automatic" SPRAY Sprinklers cost no more than old style heads.

Ask any fire insurance underwriter about "Automatic" SPRAY Sprinklers, the "sure fire killer." He knows the facts of fire and what's needed for maximum safety.

You can afford no less than the best. Get "Automatic" Sprinkler . . . . FIRST IN FIRE PROTECTION.

"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA
Offices in principal cities of
North and South America

New literature available on request

"Automatic" Sprinkler

CORPORATION OF AMERICA . YOUNGSTOWN, OHIO

Don't Overlook the Connecting Link

The connecting link between the private fire alarm system or sprinkler system and the Municipal Fire Alarm System is the Master Box.

Your fire losses are beyond the curb line. And you aren't getting 100% value from your alarm system unless your city circuits are interconnected through the Master Box to industrial plants, schools and public buildings.

Protect yourself and your citizens *all the way*. Close up the gap. Remember, you depend on industry — it's up to you to protect it.

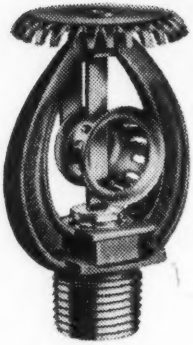
GAMEWELL

THE GAMEWELL COMPANY

NEWTON UPPER FALLS 64, MASS.

In Canada: Northern Electric Co., Ltd., Belleville, Ontario

Different
In
Method



Spectacular
In
Performance

The Grinnell SPRAY Sprinkler

Cools fire gases to prevent fire spread . . . by faster evaporation of smaller water droplets.

Controls fire by producing an unburnable mixture of flammable vapors and water vapor.

Dilutes and diminishes supply of flammable vapors with water vapor . . . evaporation of water removes heat, stops distillation of flammable vapors from solids, many liquids.

- **Better protection — the greater the hazard, the greater the improvement in protection.**
- **More efficient water distribution . . . *less* water puts out *more* fire.**
- **More uniform coverage — from multiple operation or from a single sprinkler.**
- **More effective ceiling protection, without wetting the ceiling.**
- **Lowered ceiling temperatures prevent unnecessary sprinkler openings.**
- **Interchangeable with conventional sprinklers without piping changes.**
- **Unexcelled Grinnell Quartzoid Bulb or DuraSpeed release mechanisms.**
- **Listed by Underwriters' Laboratories, Inc. and approved by Factory Mutual Laboratories.**

Grinnell Company, Inc., Providence, R. I.
Offices in principal cities of United States and Canada.

GRINNELL

FIRE PROTECTION SYSTEMS

Manufacturing, Engineering and Installation of Automatic Sprinklers Since 1878